

Table of Contents

Map of Stations	2
Executive Summary	7
Introduction	8
Bay Segment: Assawoman Bay.....	10
Station 1, Fenwick Ditch	12
Station 19, Ocean City, Caribbean St.	14
Station 32, Ocean City, 79th Street	16
Bay Segment: St. Martin River.....	18
Station 3, Ocean Pines, White Horse Park.....	20
Station 7, Ocean Pines Canal	22
Station 9, Ocean Pines Canal	24
Station 11, Bishopville Boat Landing.....	26
Station 13, Holiday Harbor	28
Station 22, Piney Island-Shingle Landing	30
Bay Segment: Isle of Wight Bay	32
Station 2, Ocean City, 36th Street	34
Station 5, Ocean City, Bluefish Cove.....	36
Station 6, Herring Creek	38
Station 4, Green Creek	40
Station 30, Turville Creek	42
Bay Segment: Sinepuxent Bay	44
Station 8, South Point	46
Station 17, Rum Point Pier	48
Station 31, South Snug Harbor	50
Bay Segment: Newport Bay	52
Station 12, Mason Landing	54
Station 15, Newport Golf Course	56
Station 23, Trappe Creek	58
Station 33, Ayres Creek	60
Bay Segment: Chincoteague Bay	62
Station 18, Figgs Landing	64
Station 20, Public Landing	66
Station 24, Kelly Point	68
Station 10, South Point Landing	70
Station 26, Lookout Point	72

Station Map

need to insert map

Table 1: Volunteers and Station Monitored

<u>Site</u>	<u>Station Name</u>	<u>Volunteers</u>
1	Fenwick Ditch	Sandy Miller & Ernie Edmond
2	Ocean City - 36th St.	Mary Lou Loesch & Jeff Anderson
3	White Horse Park	George Seymore
4	Green Creek	Chris Wade & Hollis Martin;
5	Bluefish Cove, OC	Jim Packer, Joe O'Hara & Dee Rigsby
6	Herring Creek	Jim and Nancy Harvey; MD Conservation Crew
7	Ocean Pines canal	George Staples
8	South Point	Mike and Beverly Arentz
9	Ocean Pines Canal	John McFalls
10	South Point Landing	Tom Wentz; MD Conservation Crew
11	Bishopville Boat Landing	Hobie Kernan & Mike Evans
12	Mason Landing	Janis & David Foley; MD Conservation Crew
13	Holiday Harbor	Evelyn Adams & Richard Mueller
14	Hog Landing	Bill Everett
15	Newport Golf Course	Chris Wade & Hollis Martin;
16	Manklin Creek	Bill Killinger and K MacMiller
17	Rum Point	Janet Cherrix
18	Figgs Landing	Alice Tweedy; Jeff Figgs
19	Carribean St, O.C.	Erin Fitzsimmons
20	Public Landing	Eddie Lee; Alice Tweedy
21	Assateague - Ferry Landing	Michael Goldberg & Kim Cotter
22	Piney Island/ SHLN Pr East	Mary Ochse
23	Trappe Creek	Joan Hersey & Tessa Foster; MD Conservation Crew
24	Kelly Point	Ray Jackson
25	Shingle Landing Pr. West	Alan Weirengo
26	Lookout Point	Don Winslow
30	Turville Creek	Tom & Tina Cropper; Bill Killinger and K MacMiller
31	South Snug Harbor	Joe Smith
32	North of Rte. 90	John Kelly
33	Ayres Creek	Phyllis Koeningsd

Executive Summary

Overall, the goal to collect baseline data was achieved (>84.8% of total samples collected).

Baseline Ecological Data

The St. Martin River, Sinepuxent Bay and Chincoteague Bay showed single summer (July - August) peaks in algal biomass, chl *a*, while Assawoman Bay and Newport Bay had both a spring (March and May respectively) and summer peak (July - August). Mean algal biomass was relatively stable in Isle of Wight Bay.

Nitrogen to Phosphorus ratios showed the two major freshwater input segments (St. Martin River and Newport Bay) had excessive Nitrogen levels most of the year except in the summer when the nutrients were taken up by primary producers (inversely relationship to chlorophyll). Redfield ratios in excess of 300 were seen in both systems in the late winter/ early spring. The open bay segments (Assawoman, Isle of Wight, Sinepuxent and Chincoteague) generally showed a more variable pattern of N:P ratios but were on average more P limited.

Volunteer data was highly comparable to state and federal monitoring data. The increased coverage (two sampling points per month during the non-winter months) provided greater insight to the extent and duration of algal blooms.

The 'problem' water quality habitat requirements of SAV in the coastal bays

Light attenuation (KD) and chlorophyll *a* requirements were not met the most often (26 out of 119 or 21.8% of the time and 21 of 119 samples or 17.6% of the time respectively). Thus, were the biggest problem for SAV growth in the bays based on our data. Habitat criteria were exceeded more in 1998 than in 1999 (34 exceedances out of 64 data points vs 21 exceedances out of 55 data points). KD and CHLA were the violated criteria most often in 1998 (16.4% and 11.4% respectively) while CHLA and DIP accounted for 5.8% and 3.8% of the violations respectively in 1999. DIN requirements were generally met at all stations in both years except stations in the headwaters of Newport Bay (including Mason Landing, Trappe Creek and Ayres Creek).

SAV was not present at most sites. The data collected suggests that water quality (not including total suspended solids) was inadequate for SAV growth at most stations. However, other factors may also be inhibiting SAV growth (e.g. total suspended solids, sediment type or wind stress).

Suggested Program Modifications

- If money is available, expand parameters monitored to include TSS and expand nutrients to all stations. This would allow complete coverage of all SAV habitat parameters. Light meters should be used instead of secchi at shallow stations that are consistently unable to obtain readings and filtration should be switched to a negative pressure method.

Disclaimer

- This report does not adequately address all water quality issues in the coastal bays. 1. Sample design does not allow for an unbiased estimation of ecosystem condition. 2. Recent studies have shown that organic nutrients (this program only measures dissolved inorganic nutrients) may be the major water quality problem in the bays. 3. Nutrients may be taken up by other primary producers such as macroalgae (e.g. seaweeds) and not observed in the water column or algal biomass.

Introduction

The Maryland Coastal Bays National Estuary Program, MCBP, is dedicated to the preservation and improvement of the coastal bays resources. To help achieve this goal, volunteer water quality monitoring was started by the MCBP citizens advisory committee and MCBP staff in 1997.

This program will be integrated into a larger MCBP monitoring program, which includes expanding existing data collection efforts to establish a unified long term data collection, management, and analysis system.

I. GOALS

The main objective of the Maryland coastal bays volunteer water quality monitoring program was to document baseline conditions (this data may be used for future trend analysis). Such baseline data will help in identifying pollution sources and evaluating the effectiveness of implemented actions in the watershed as part of the Maryland Coastal Bays Comprehensive Conservation Management Plan.

GOAL 1: Collect data from at least three (3) stations in each bay segment.

GOAL 2: Collect 80% of scheduled samples from each segment.

A second objective was to compare water quality conditions to water quality criteria needed for seagrass growth.

GOAL 3: Determine the number of stations that meet SAV habitat conditions.

II. SAMPLE DESIGN

Dedicated volunteers monitor water quality twice a month from March through October and once a month in December, January and February (table 1).

Volunteers monitor the following parameters at all stations: temperature, salinity, water depth, secchi depth (measures water clarity), chlorophyll a (measures algae abundance). The following nutrients were measured at select stations due to limited funding: nitrate/nitrite, ammonia and phosphorus (check Appendix A to see which parameters are monitored at each station).

For more information on the methods used by the MCBP Volunteer Water Quality Monitoring Program please refer to the monitoring manual.

III. IMPORTANCE OF WATER QUALITY MEASUREMENTS

To restore the bays, we must ensure that water quality conditions remain within the optimal range for the health and vitality of native species. As scientists determine the ideal habitat conditions for each species, monitoring data will be instrumental in judging how often conditions are suitable for the survival and propagation of these species. Certain water quality parameters such as nutrients, phytoplankton/algae, and seagrasses are very good indicators of environmental health. The coastal bays volunteer monitoring program uses nutrients and phytoplankton abundance in addition to variables such as temperature, salinity, pH and water clarity to characterize the bays. In addition the program has gathered data from other monitoring programs on the abundance of seagrasses in the bays to compare to water quality at the monitoring stations and help characterize water quality in the bays.

Water Temperature

Temperature, probably the most easily measured parameter, is a critical factor in the workings of the bays ecosystem. As water temperature rises, biological and chemical activity also increase.

Many species regulate the timing of important events, such as reproduction and migration, according to specific water temperatures. Optimal temperatures (which vary with the species and their life stage) allow organisms to function at maximum efficiency. The slow change of temperature that comes with the seasons permits organisms to acclimate, whereas rapid shifts may adversely affect plants and animals.

Salinity

Salinity is simply a measure of the amount of salts dissolved in water. An estuary usually exhibits a gradual change in salinity throughout its length as fresh water flowing from the tributaries mixes with sea water moving in from the ocean. Even at a single place in an estuary, salinity will fluctuate with movement of the tides, dilution by precipitation and seasonal fresh water inflow.

Salinity levels control, to a large degree, the types of plants and animals that can live in different zones of the bays. Freshwater species may be restricted to the upper reaches of the estuary while marine species inhabit the estuarine mouth. Some species tolerate only intermediate levels of salinity while broadly adapted species can acclimate to any salinity ranging from fresh water to seawater.

Salinity measurements may also offer clues to the areas of an estuary that could become afflicted by salinity-specific diseases. For example, pathogens infecting the oysters are restricted to sections which fall within certain salinity levels. Drastic changes in salinity, such as those due to drought or storms, can also greatly alter the numbers of animals and plants in the bays.

pH

The pH quantifies the acidity or alkalinity of a water sample. Pure water has a pH of 7.0 and is neutral; water measuring under 7.0 is acidic and that above 7.0 is alkaline or basic. Most marine organisms prefer conditions with pH values ranging from about 6.5 to 8.5. Levels of pH fluctuate over time in an estuary. Estuarine pH levels generally average from 7.0 to 7.5 in the fresher sections to between 8.0 and 8.6 in the more saline areas. Several other factors also determine the pH of the water including: bacterial activity, rate of photosynthesis (changes the level of carbon dioxide), water turbulence, chemicals in runoff, human activities both in and outside the drainage basin (such as acid rain).

Human activities that cause large, short-term swings in pH or long-term acidification of a water body are exceedingly harmful. For instance, algal blooms which are often initiated by an overload of nutrients can cause pH to fluctuate dramatically over a few hour period, greatly stressing local organisms. Acid precipitation, or “acid rain”, in the upper, freshwater reaches of a bay can diminish the survival rate of eggs deposited there by spawning fish.

The pH of the water is critical to the survival of most aquatic plants and animals. Many species have trouble surviving if pH drops under 5.0 or rises above 9.0. Changes in pH can alter other aspects of the water’s chemistry, usually to the detriment of native species. Even small shifts in the water’s pH can affect the solubility of some metals such as iron and copper.

Water Clarity

Water clarity is a measure of the amount of light that is able to penetrate through the water. The amount of material suspended in the water, turbidity, reduces water clarity. Although we often think that clean water is clear, even unpolluted water can have suspended particles that may lessen its clarity but do not diminish its quality. Measure of turbidity indicate how cloudy or muddy the water is or, alternatively, the degree of its clarity or translucence. Several types of suspended material may cause water turbidity including: suspended silt of soil particles, phytoplankton and zooplankton (tiny floating organisms), and minute fragments of dead plants.

Natural runoff, water turbulence from storms, and wave action can cause turbidity in the water. Human activities, however, exacerbate the clouding. Runoff from agricultural fields, wash from construction sites and urban areas, and shoreline erosion from heavy boat traffic, among other problems, all contribute to high turbidity.

High levels of turbidity over long periods of time can greatly diminish the health and productivity of the bays. Turbid waters decrease light penetration into the water, thereby reducing the area available for seagrasses to grow.

Many animals living in the bays feed by filtering the water; suspended material in large quantities can foul their filter-feeding systems. Particles may accumulate on the gills of fish and inhibit breathing. High turbid water also hinders aquatic predators from spotting and tracking down their prey.

Algae

The abundance of phytoplankton, or algae, is measured by the quantity of light absorbing pigments known as chlorophyll a. An overabundance of nutrients can trigger uncontrolled growth of phytoplankton (microscopic floating plants also known as algae) - often referred to as blooms. Such high levels of algae can shade underwater plants (seagrasses). As discussed in the nutrient section below an overabundance of phytoplankton can alter the water chemistry and also lead to decreased oxygen levels for aquatic plants and animals.

Natural cycles of phytoplankton show low levels in the winter and higher levels, known as blooms, in the spring or early summer. Nutrient cycling in the water can also lead to smaller blooms in the fall.

Nutrients

Nitrogen and phosphorus are two of the many nutrients critical for the survival of aquatic species. Nitrogen's primary role in organisms is protein synthesis, plants also use this substance in photosynthesis. Phosphorus is critical for metabolic processes which involve the transfer of energy. In estuaries where human impact is minimal, either nitrogen or phosphorus is usually in limited supply. Human activities, however, often drastically change the chemistry of estuarine waters.

Nutrient levels are typically low in the winter (when biologic activity is low) and higher levels in the spring or early summer - typically associated with land runoff from spring rains. Nutrients may also be recycled within the bay during the summer months.

Nutrient levels in an estuary are closely related to the level of oxygen in the water. Excess nutrients cause a proliferation of phytoplankton which may create a daily increase of oxygen in the surface waters. When these phytoplankton die, sink and are decomposed by oxygen-consuming bacteria, oxygen levels near the bottom plummet. Under the worst conditions, the bottom waters of an estuary turn anoxic (totally without oxygen). This can kill the fish and shellfish living in the area. Due to the shallow nature of the coastal bays and the fact

that they do not stratify (set up two distinct layers), oxygen can be readily mixed into the water column from wind or photosynthesis. Therefore, oxygen problems in the bays may be greatest near dawn and in areas that are not well mixed.

IV. RELATIONSHIP TO THE ENVIRONMENT

In addition to providing baseline conditions, this reports relates water quality data from the Maryland Coastal Bays Volunteer Water Quality Monitoring Program to habitat requirements needed for the growth of seagrass. The habitat requirements were developed for the Chesapeake Bay; however, recent studies from the University of Delaware have confirmed most of these are applicable in the coastal bays (discrepancies exist with light attenuation and total suspended solids). Since the light attenuation, KD, requirement for the coastal bays is still being debated, we chose to use the original Chesapeake Bay requirement since it was based primarily on eelgrass which is one of the dominant species in the coastal bays.

Although seagrasses in Maryland's coastal bays have been increasing over the past 10 years; seagrasses do not cover all of their potential habitat area. Scientists believe that this may be due to poor water quality in some areas; however, other factors affecting the distribution of seagrasses in the coastal bays may include sediment differences and high wave energy in some areas.

Data on four of the five critical water quality parameters necessary for the growth of seagrasses were measured by volunteer monitors including dissolved inorganic phosphorus, dissolved inorganic nitrogen, chlorophyll a, and light attenuation (light extinction coefficient determined from secchi depth); data on total suspended solids - the last critical parameter - was not collected. Only two of the five parameters were measured at other sites. Physical data including temperature and salinity will also be related to optimal growing conditions for eelgrass, *Zostera marina*, a true seagrass species common to the coastal bays.

insert table 3 - SAV habitat parameters

V. DATA QUALITY

Volunteer data integrity is ensured by following the Quality Assurance Project Plan for the MD Coastal Bays Volunteer Monitoring Program (1998).

VI. DATA ANALYSIS

Baseline Conditions (Water Quality Status)

Station mean and ranges were determined for each parameter collected (for entire time sampled).

Bay segment means and ranges were analyzed for chlorophyll and DIN:DIP.

Seagrass Habitat Conditions

Since seagrasses were not present at most stations (Figure 2), the data were analyzed to determine if water quality may be a controlling factor limiting seagrass growth. Water quality data from April through October (the widgeon grass growing season) was analyzed to determine if seagrass habitat criteria were met at each station. Widgeon grass (one of only two seagrasses found in the coastal bays) was chosen because it is the pioneering species (e.g. typically colonizes an area first). The attainment of SAV habitat requirements was tested with the Wilcoxon one-sample test, classifying the results into 3 categories using a significance level (P) of 0.05. If the median was significantly below the requirement it was “met;” if it did not differ significantly it was “borderline;” and if it was significantly above the requirement it was “not met.” Since many outcomes were borderline, borderline results were further classified as ‘borderline-met’ (if the median did not exceed criteria) or ‘borderline- not met’ (if the median was greater than the habitat requirement) for purposes of summarizing the data.

Analyses were done by station and by bay segment (Tables 2 - 6). Samples sizes are larger when stations are combined in segments, raising the power of the Wilcoxon test, making it less likely to have a borderline result. Although the potential sample size per year is 14 (two samples per month during the growing season), many sites have a smaller sample size per parameter (see Appendix A for sample sizes). Due to the smaller sample size, attainment can be borderline even when the median is 45% or more above or below the habitat requirement, if the data are variable enough. Station with identical medians can have one classified not met and one borderline, again due to different variability. One station could have all values above the median, classified as not met, while the other could have a wider spread with some above and some below the median, classified as borderline.

VII. DATA COMPARISONS

Volunteer data was related to data collected from nearby sites monitored by other programs (e.g. DNR Pfiesteria monitoring and the Assateague Island National Seashore Water Quality monitoring program) when stations were within X meters of each other (Figure 3).

Summertime conditions were compared to other state and federal water quality monitoring programs (DNR, MDE and NPS).



Assawoman Bay contained three monitoring stations:

Site 1 Fenwick Ditch

Site 19 Ocean City., Carribean St.

Site 32 Ocean City., 79th St.



WATER QUALITY STATUS

Chlorophyll *a*

The annual mean chlorophyll value was 18.9 for 1997, 21.8 for 1998 and 12.5 for 1999.

The collection goal was not met - only 65% of chlorophyll samples were taken.

Chlorophyll *a* concentrations in Assawoman Bay were generally above the SAV habitat value of 15 ug/l. Mean monthly peak biomass was in July with a smaller peak in March. Station 32 had the greatest range in values (up to 90 ug/l).

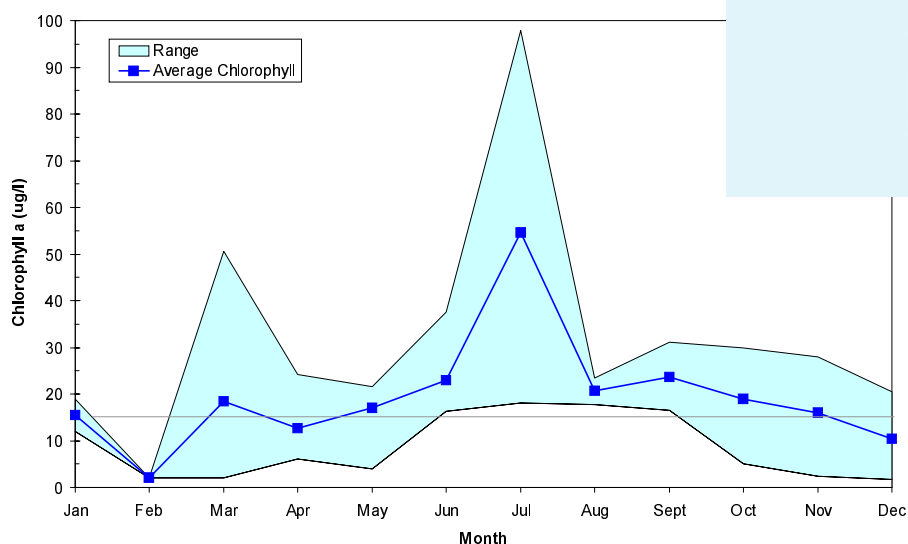


Figure XX: Monthly mean chlorophyll *a* concentrations in Assawoman Bay compared to range for 1997 - 1999. Insert graph shows chlorophyll *a* range by station.

Redfield Ratio (DIN:DIP)

Redfield ratios show that overall Assawoman Bay is nitrogen limited (e.g. phosphorus enriched at the molar level).

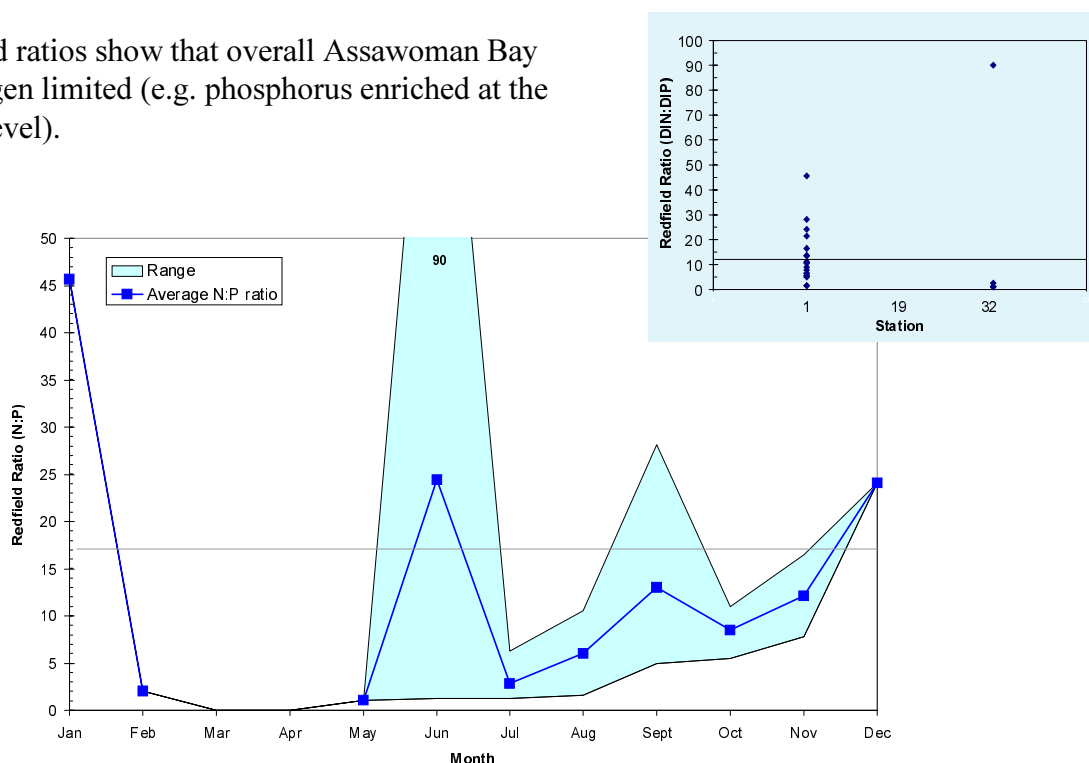


Figure XX: Monthly mean Redfield Ratios in Assawoman Bay compared to range for 1997 - 1999. Insert graph shows DIN:DIP range by station.

SEAGRASS HABITAT CONDITIONS

In 1998 50% of the SAV habitat requirements were met in Assawoman Bay while 75% were met in 1999. DIN and DIP was attained at Fenwick Ditch (the only Assawoman Bay station that measured these parameters) at all sample points.

Site #	Location	1998	1999	TOTALS
1	Fenwick Ditch	2/4 (CHLA, KD)	3/4 (KD)	5/8
19	OC, Carribean st.	NSD	ND	NSD
32	OC, 79 th st.	1/2 (CHLA)	ND	1/2
TOTALS		3/6	3/4	6/10

Table 2: Number of SAV habitat requirements met or borderline by site and year for the MD coastal bays water quality monitoring sites in Assawoman Bay, 1998 & 1999.

Station 1 Fenwick Ditch

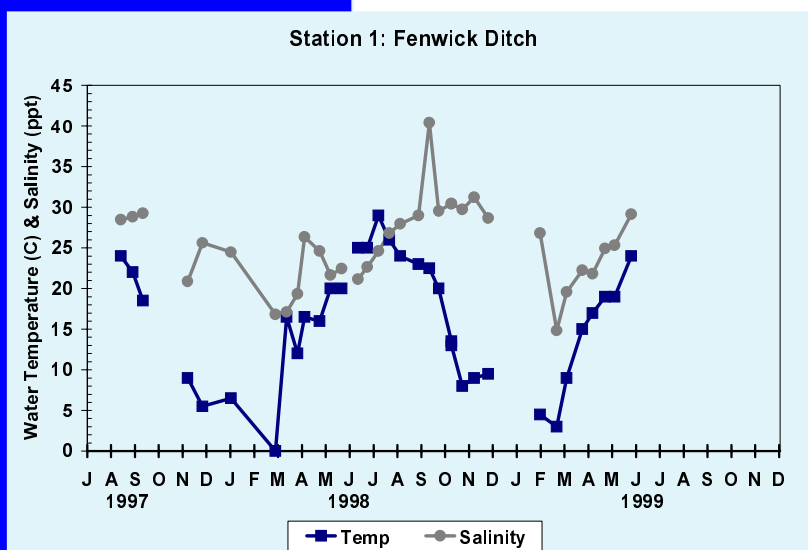
Fenwick Ditch is located in the Assawoman Bay watershed. The site is characterized as separating Little Assawoman Bay, Delaware from Big Assawoman Bay, Maryland, and is located near the state line. This site is very important in helping to characterize the relationship between these two bays since there is extremely limited data on Little Assawoman and whether it is a source of nutrients to Maryland's Coastal Bays. This site has been monitored continuously since August 1997 giving an extremely good data record.



Station Characterization

The average depth of the station was 3 meters with an approximate 1.4 meter observed water level range. This station exhibited polyhaline salinity levels between 18 and 30 ppt with the lowest salinities in the early spring. The water temperature pattern is best described as a sinusoidal pattern of fluctuation

Parameter	Mean	Minimum	Maximum
Depth (m)	3.0	2.3	3.7
Secchi (m)			
Temperature (°C)	16.5	0	29
Salinity (ppt)	25.6	14.8	40.4
pH	8.2	8	9
chlorophyll a (ug/l)	18.5	6.0	50.6
Nitrate/Nitrite (uM)	3.7	bdl	36.7
Ammonia (uM)	3.28	0.3	22.7
DIN (uM)	3.7	0.3	23.9
PO ₄ (uM)	0.27	0.08	0.72



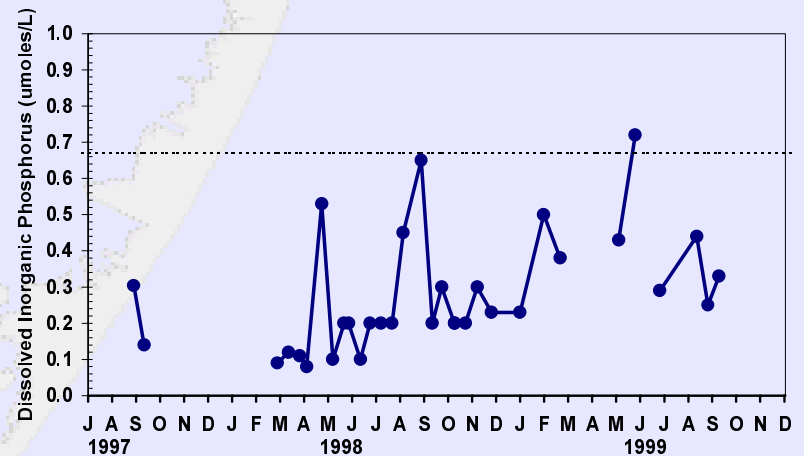
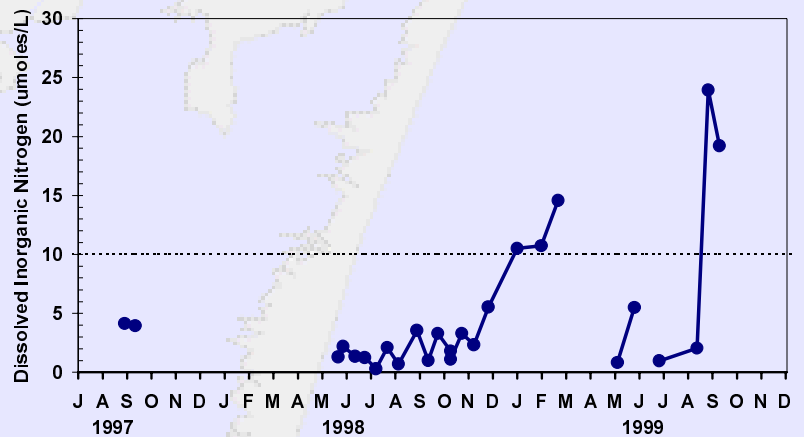
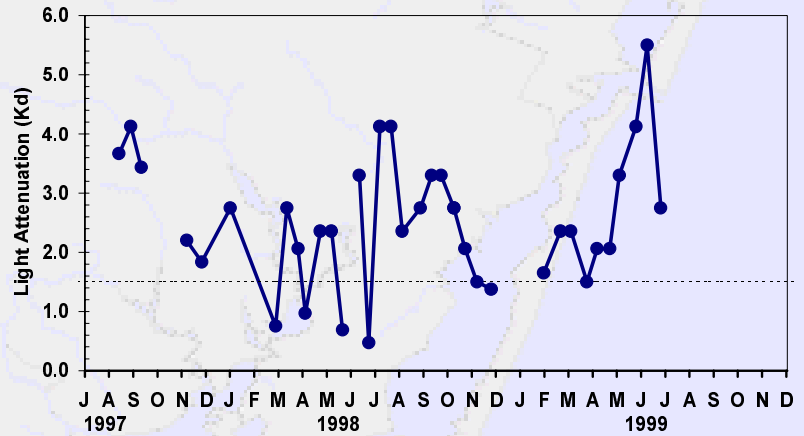
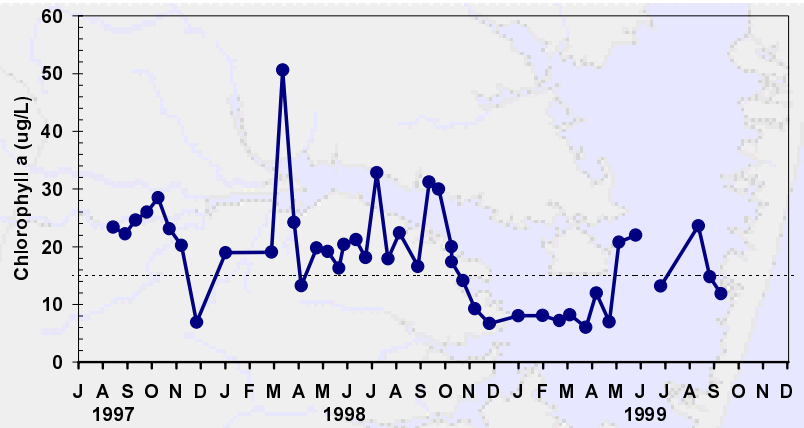
throughout the year. The low records are in December through March and the peak in monthly mean temperature is in July and August. The pH levels are generally in range for marine life. Slight deviations may be due to the broad range colorimetric technique used for pH determination or other factors (see Introduction for factors affecting pH).



Seagrass Criteria

DIN and DIP levels met SAV habitat requirements all of the time during the growing season during 1998. While chlorophyll a levels and light attenuation exceeded SAV habitat requirements. Concentrations remained high for most of the time during the growing season (CHLA failed 15 out of 16 times & KD failed 12 out of 15).

In 1999, all four habitat requirements were borderline with the medians for three of the parameters (DIN, DIP, CHLA) below the reference criteria. The habitat criteria for KD was exceeded 6 out of 7 times (mean value = 2.75) but it was not significant (at the $p=0.05$ level).



Station 19 Ocean City, Caribbean St.

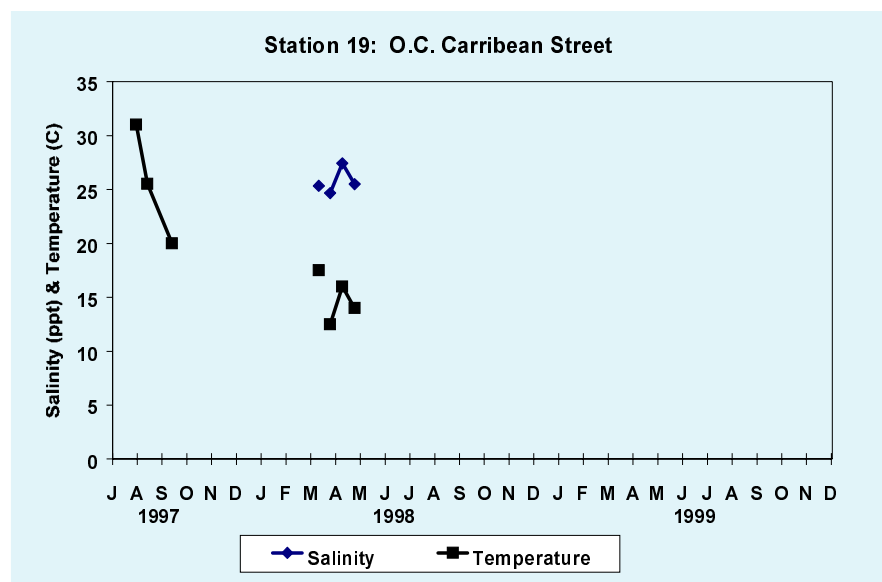
This station is located in the Assawoman Bay watershed. This station is located in a large seagrass bed located behind Ocean City. There is no other similar data collected nearby. Station 19 has been monitored by Erin Fitzsimmons since August 1997.

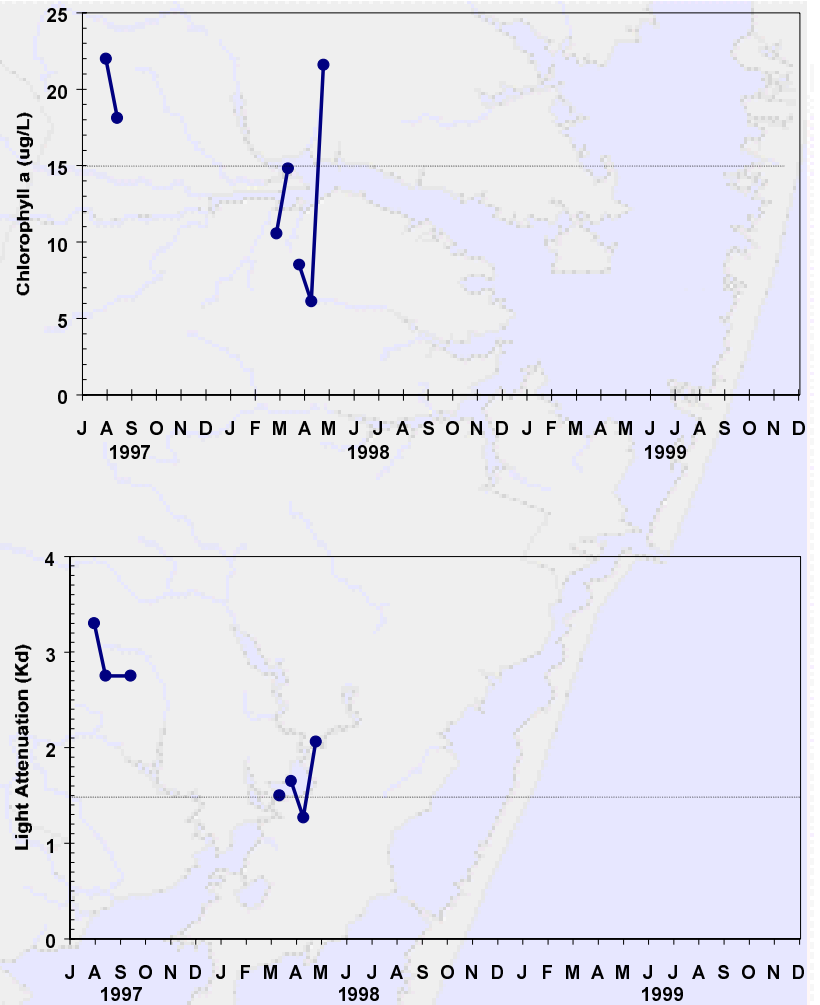


Station Characterization

Although there is limited data from this station, the average recorded depth of this station was 1.7 meters with an approximate observed water level range of 0.8 meters. This station exhibited polyhaline salinity levels between 25 and 28 ppt. The pH levels are in range for marine life.

Parameter	Mean	Minimum	Maximum
Depth (m)	1.7	1.2	2.0
Secchi (m)	.8	.5	1.3
Temperature (°C)	19.5	12.5	31.0
Salinity (ppt)	25.73	24.66	27.44
pH	8.3	8	8.5
chlorophyll a (ug/l)	14.25	6.12	22





Seagrass Criteria

Not sufficient data to do analysis (need a minimum of three sample dates spread out within SAV growing season). The spring data that was available did show CHLA and KD medians below habitat criteria.

Station 32 Ocean City, 79th Street

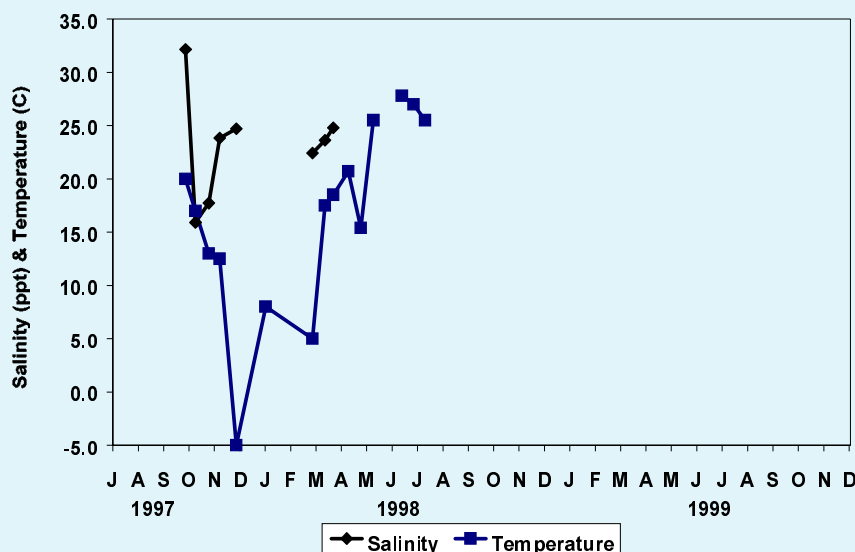
This station is located in the Assawoman Bay watershed. The station is within a large seagrass bed located behind Ocean City. There are no other similar data collected nearby.



Parameter	Mean	Minimum	Maximum
Depth (m)	.55	.20	.70
Secchi (m)	nd	nd	nd
Temperature (°C)	16.56	-5	27.8
Salinity (ppt)	23.33	9.55	32.16
pH	7.8	7.2	8.3
chlorophyll a (ug/l)	24.06	4.04	98.0
Nitrate/Nitrite (uM)	8.0	0	57.28
Ammonia (uM)	nd	nd	nd
DIN (uM)	nd	nd	nd
PO ₄ (uM)	.77	.05	1.89

Station Characterization

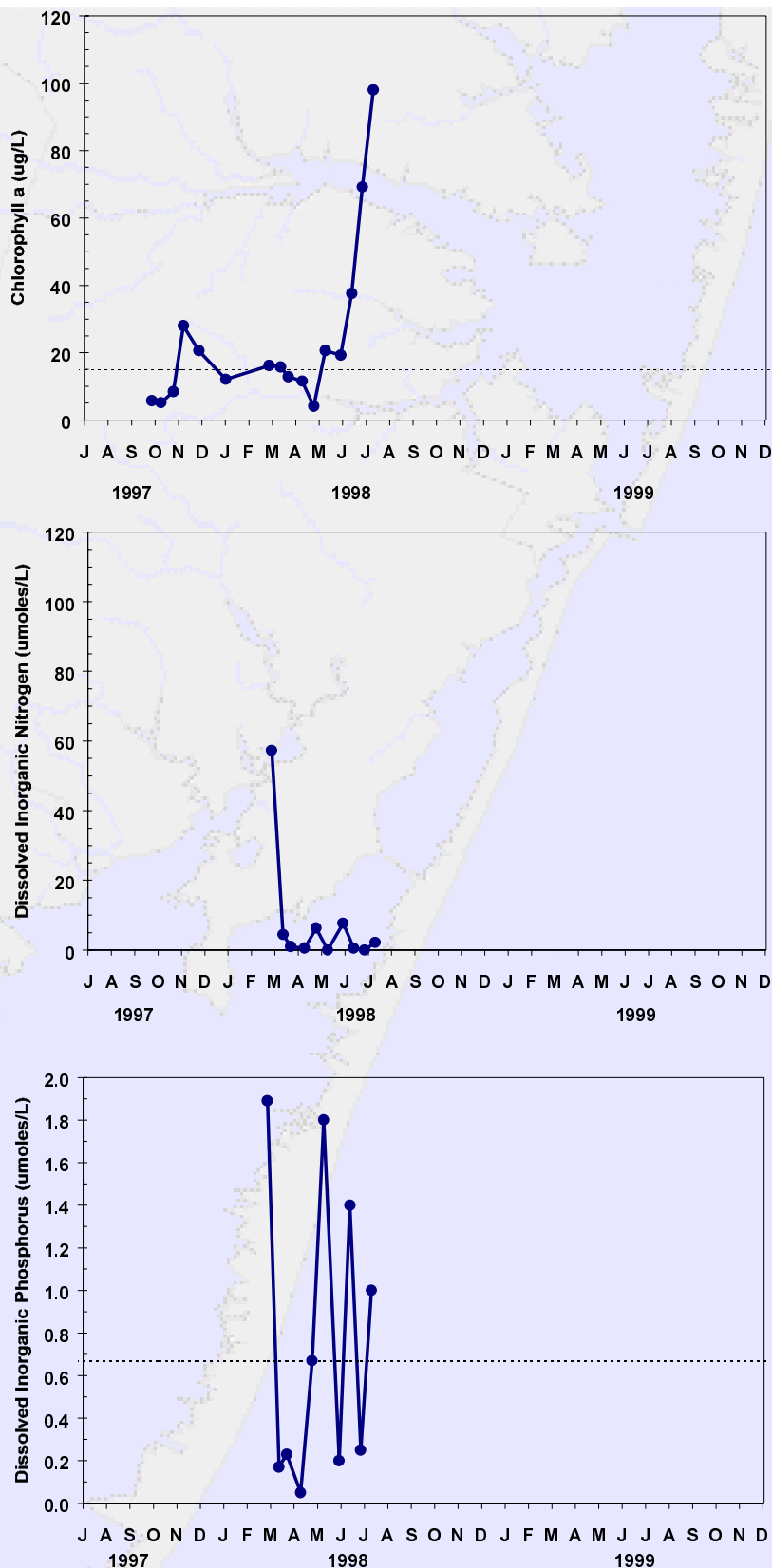
The average depth of this station was 0.6 meters with a approximate 0.5 meter observed water level range. This station had salinity levels between 10 and 32 ppt. The water temperature pattern is best described as a sinusoidal pattern of fluctuation throughout the year. The low records for the year are in December through March and the peak in monthly mean temperature is July and August. The pH levels are in range for marine life.





Seagrass Criteria

In 1998, DIP and CHLA were borderline. DIP met criteria for 4 out of 7 samples with a median (0.46) below the criteria. CHLA failed 5 out of 8 samples with a median (19.93) above the criteria. KD was not included in the analysis because of lack of data. The lack of data was due to the secchi remaining visible on the bay bottom; hence, there was sufficient light at that station for seagrass growth. However, it can not be estimated if the area met the SAV requirement due to the mean station depth being less than 1 meter (the goal of the habitat requirement).





Site 11 Bishopville Boat
Site 13 Holiday Harbor
Site 22 Piney Island

St. Martin River contained the following
six monitoring stations:

Site 3 White Horse Park
Site 7 Church Creek
Site 9 Ocean Pines Canal



WATER QUALITY STATUS

Chlorophyll *a*

The annual mean chlorophyll value was 24.4 for 1997, 38.4 for 1998 and 26.9 for 1999.

The collection goal was met - 94.9% of chlorophyll samples were taken.

Chlorophyll *a* concentrations in the St. Martin River were generally above the SAV habitat value of 15 ug/l. Mean monthly peak biomass was in July. Station 11 had the greatest range in values (up to 160 ug/l).

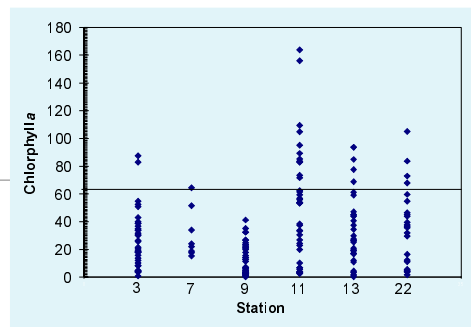
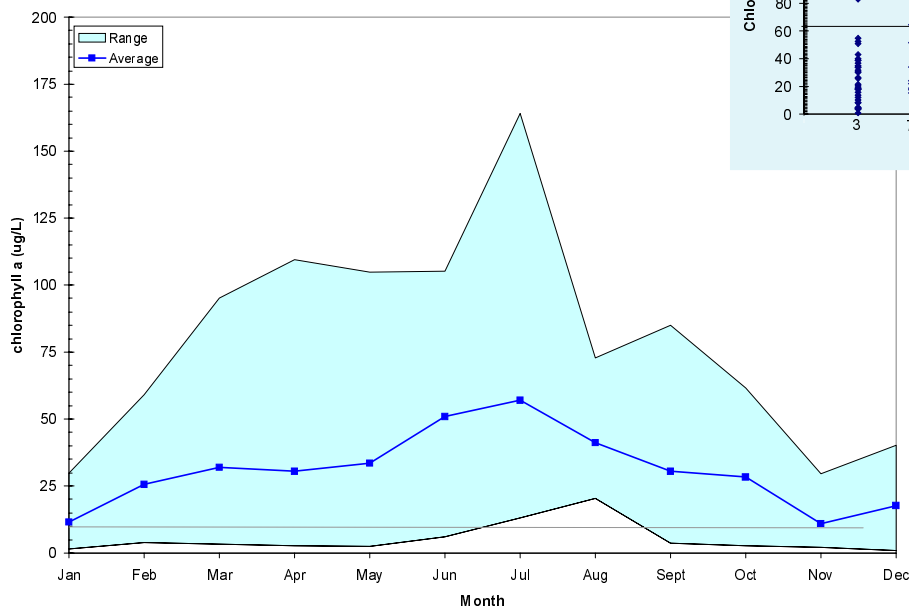


Figure XX: Monthly mean chlorophyll *a* concentrations in the St. Martin River compared to range for 1997 - 1999. Insert graph shows chlorophyll *a* range by station.

Redfield Ratio (DIN:DIP)

Redfield ratios show that overall the St. Martin River is phosphorus limited (e.g. nitrogen enriched at the molar level). As nitrogen is taken up by algae the system becomes nitrogen limited in June and July.

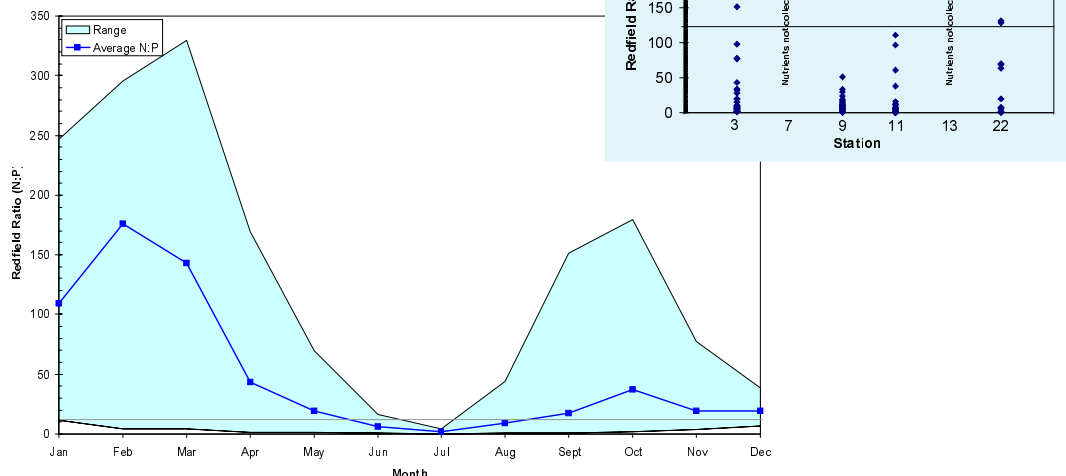


Figure XX: Monthly mean Redfield Ratios in Assawoman Bay compared to range for 1997 - 1999. Insert graph shows DIN:DIP range by station.

SEAGRASS HABITAT CONDITIONS

In 1998 61(65)% of the SAV habitat requirements were met in St. Martin River while 70% were met in 1999. KD requirements were not met most often in 1998 (22/20% of the time) while CHLA requirements were not met most often in 1999 (20%). DIN and DIP criteria were attained at all stations where the parameters are measured in the St. Martin River.

Site #	Location	1998	1999	TOTALS
3	White Horse Park	2/4 (CHLA, KD)	2/4 (CHLA, KD)	4/8
4	Green Creek	ND	ND	ND
7	Ocean Pines	0/2 (CHLA, KD)	ND	0/2
9	Ocean Pines Canal	1/4 (CHLA, KD, DIP)	2/4 (KD, DIP)	3/8
11	Bishopville Boat	1/4 (CHLA, KD, DIP)	1/4 (CHLA, KD, DIP)	2/8
13	Holiday Harbor	0/2 (CHLA, KD)	0/2 (CHLA, KD)	0/4
22	Piney Island	2/4 (CHLA, KD)	NSD	2/4
25	Piney Island	ND	ND	0
26	Lookout Point	0/1	0/2	0/3
TOTALS		6/21	5/16	11/37

Station 3 White Horse Park

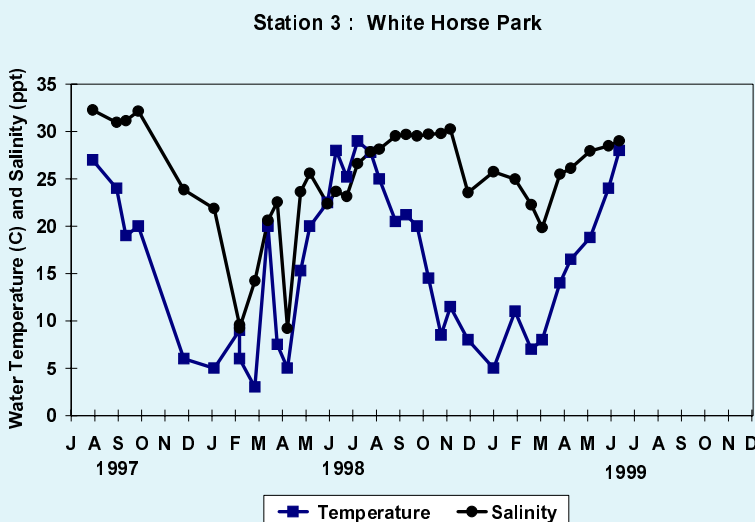
This station is located in the St. Martin River segment (Isle of Wight watershed) within the Ocean Pines development. This station is not near any known seagrass beds. Although DNR monitors the St. Martin, no other similar data collected nearby. Station 3 was monitored by George Seymore from August 1997 through April 1999.



Station Characterization

The average depth of this station was 1.2 meters with a 1.3 meter observed water level range. This station exhibited a large range in salinity levels from 9 to over 30 ppt. Salinities were more variable in 1998 with the lowest salinities in the late winter/early spring. The water temperature pattern is best described as a sinusoidal pattern of fluctuation throughout the year. The low records for the year are in December through March and the peak in monthly mean temperature is July and August. The pH levels are generally in range for marine life. Slight deviations may be due to the broad range colorimetric technique used for pH determination or other factors (see Introduction for factors affecting pH).

Parameter	Mean	Minimum	Maximum
Depth (m)	1.19 m	.8 m	2.1m
Secchi (m)	.72 m	.4 m	1.3 m
Temperature (°C)	16.36°C	3°C	29°C
Salinity (ppt)	24.87 ppt	9.2 ppt	32.28 ppt
pH	8	7.5	9.3
chlorophyll a (ug/l)	28.16 ug/l	3.4 ug/l	87.6 ug/l
Nitrate/Nitrite (uM)	7.1 uM	.1 uM	93.75 uM
Ammonia (uM)	3.3 uM	.27 uM	15.36 uM
DIN (uM)	10.8 uM	.7 uM	93.75 uM
PO ₄ (uM)	.46 uM	.13 uM	1.23 uM

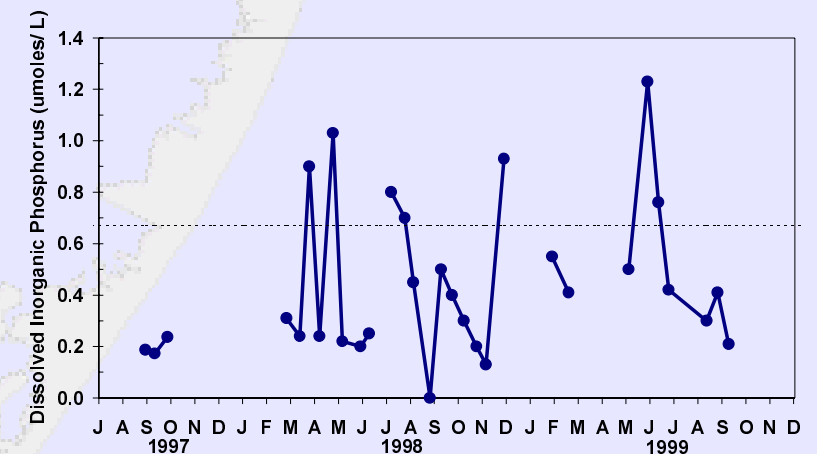
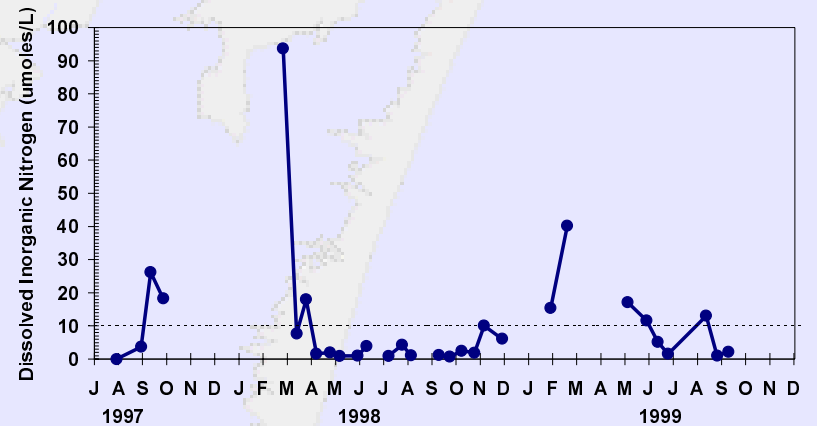
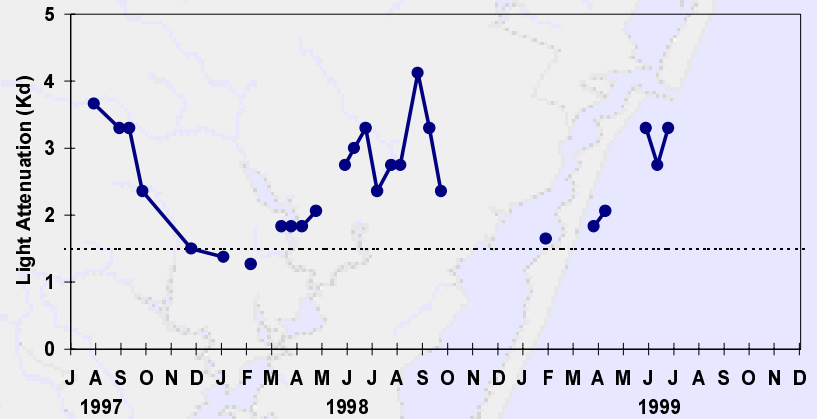
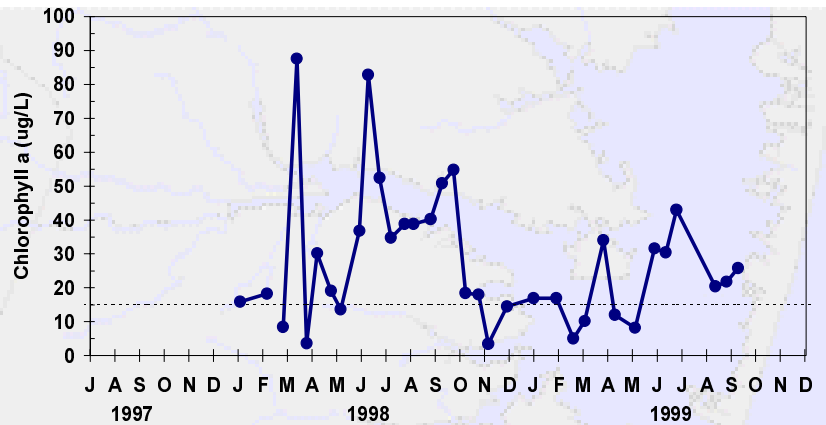




Seagrass Criteria

During 1998, DIN levels met SAV habitat requirements during most of the growing season and DIP levels were borderline (mean value of 0.43). While chlorophyll a levels and light attenuation exceeded SAV habitat requirements during the growing season (CHLA failed 12 out of 15 times & KD failed 12 out of 12).

In 1999, all four habitat requirements were borderline with medians for two of the parameters (DIN, DIP) below the reference criteria. The habitat criteria for KD was exceed 6 out of 7 times but it was not significant at the $p=0.05$ level (median = 2.75). Chlorophyll a was borderline with a median value of 25.8 (exceeded 7 out of 9).



Station 7

Ocean Pines Canal

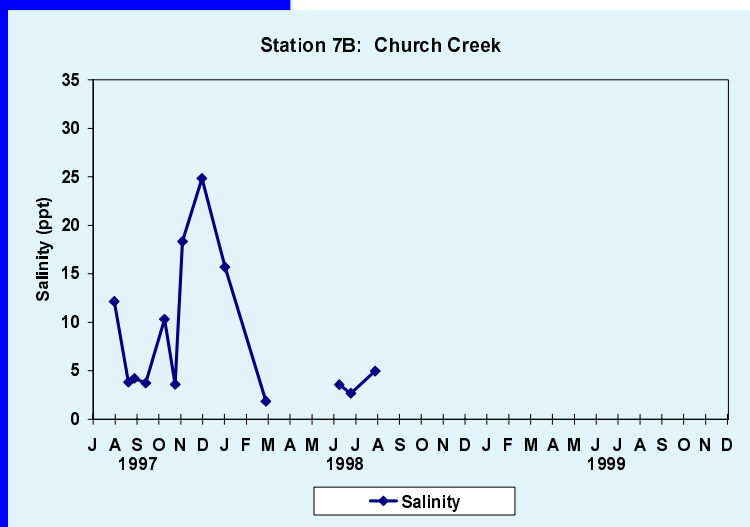
This station is in the Isle of Wight watershed. There are no documented seagrass beds nearby. There is no similar data collected nearby.



Parameter	Mean	Minimum	Maximum
Depth (m)	1.35	1.0	2.7
Secchi (m)	.78	.50	1.30
Temperature (°C)	17.46	6.0	28.5
Salinity (ppt)	8.44	1.84	24.83
pH	8	7.7	8.5
chlorophyll a (ug/l)	19.04	0	64.4

Station Characterization

The average depth of this station was 1.35 meters with a 1.7 meter observed water level range. This station exhibited polyhaline salinity levels generally between 18 and 30 ppt. This station had widely variable salinities with the highest salinities in the late winter. Water temperature low records were recorded in November through March and the peak in monthly mean temperature in the summer. The pH levels are generally in range for marine life.

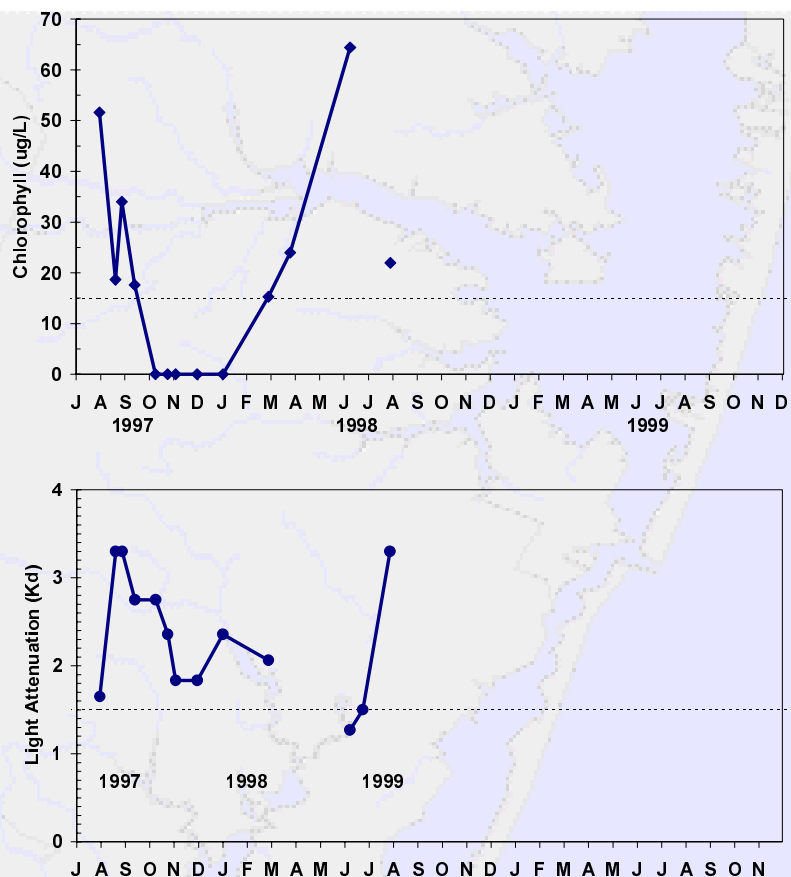


Seagrass Criteria

This station does not measure the DIN and DIP habitat requirements.

In 1998, chlorophyll a and KD habitat requirements were borderline. Chlorophyll a levels exceeded SAV habitat requirements (median = 23) at all four sample points but was not significant at the 0.05 level. KD met SAV habitat requirements 2/4 with a median value of 1.74.

There was no data collected at this station in 1999.



Station 9

Ocean Pines Canal

This stations is in the St. Martin River (within the Isle of Wight watershed). The station is not near any documented seagrass beds. There is no other similar data collected nearby.

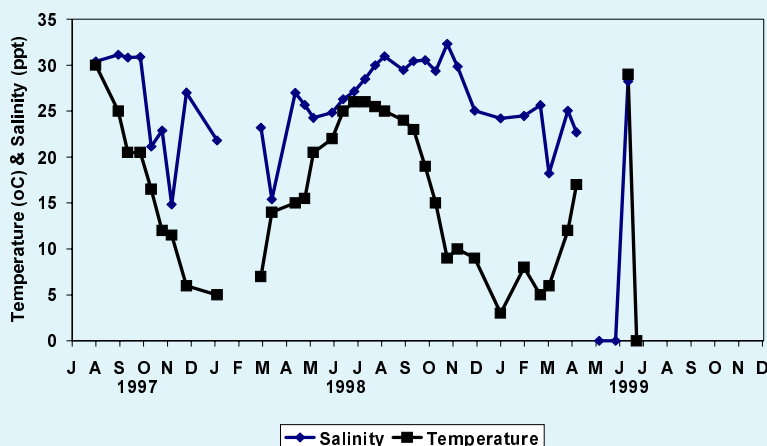


Parameter	Mean	Minimum	Maximum
Depth (m)	1.25	.80	2.1
Secchi (m)	.82	.40	1.4
Temperature (°C)	16.4	3.0	29.0
Salinity (ppt)	26.16	14.85	32.34
pH	8	8	8.3
chlorophyll a (ug/l)	13.4	1.29	35.2
Nitrate/Nitrite (uM)	1.55	0	5.65
Ammonia (uM)	6.32	.18	24.19
DIN (uM)	6.94	.25	27.36
PO ₄ (uM)	.71	.11	1.8

Station Characterization

The average depth of this station was 1.25 meters with a 1.3 meter observed water level range. This station generally exhibited polyhaline salinity levels between 15 and 32 ppt. The water temperature pattern is best described as a sinusoidal pattern of fluctuation throughout the year. The low records for the year are in December through March and the peak in monthly mean temperature is June through August. The pH levels are generally in range for marine life.

Station 9: Ocean Pines Canal

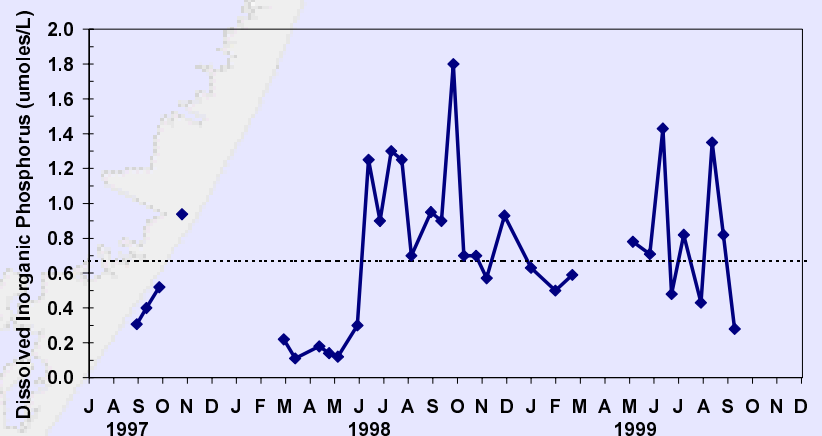
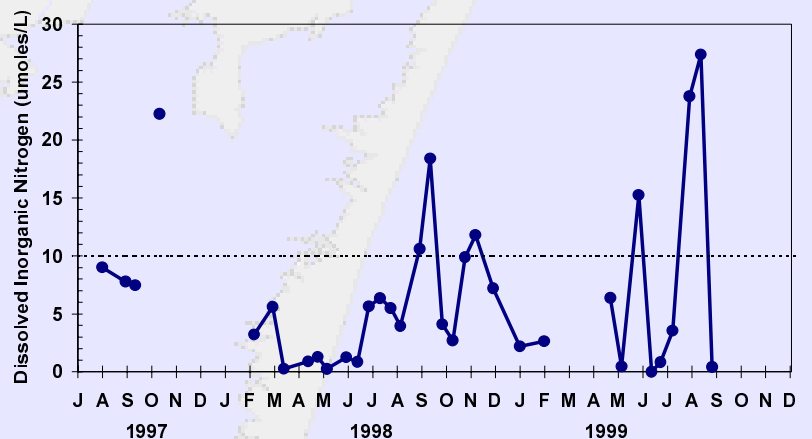
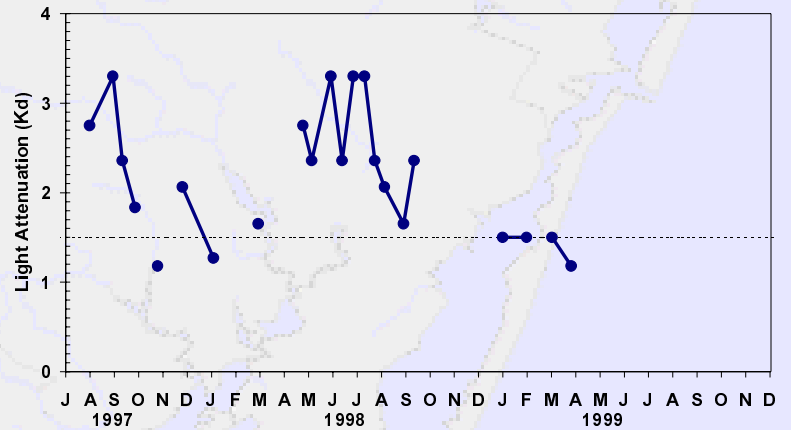
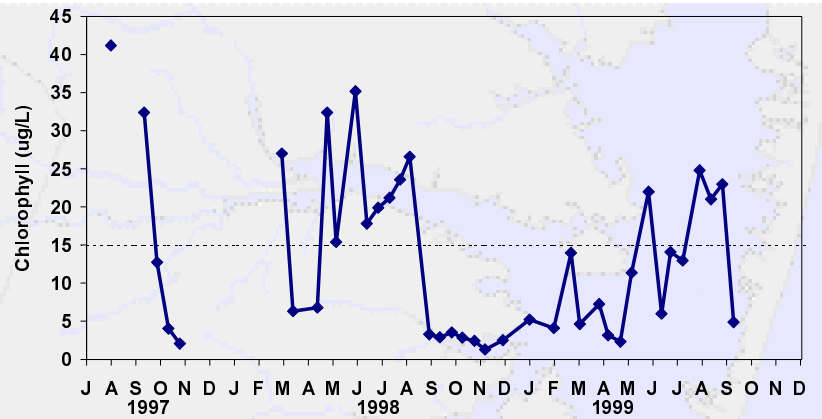




Seagrass Criteria

In 1998, KD was not met. The median values for DIP and CHLA (0.9 and 17.82 respectively) exceeded the habitat requirements (9 out of 13 times and 8 out of 13 times respectively) for SAV they were borderline (not significant at the 0.05 level). DIN criteria was met criteria (median of 3.95).

In 1999, all parameters were borderline. Median values for DIP and KD did not meet criteria (0.78 and 2.75 respectively) while DIN and CHLA medians met requirements (4.97 and 12.18 respectively).



Station 11 Bishopville Boat Landing

This station is in the St. Martin River segment (Isle of Wight watershed). This station has been monitored by Mike Evans continuously since August 1997. No seagrass nearby. Near Pfiesteria BSP00xx.



Parameter	Mean	Minimum	Maximum
Depth (m)	.52	.2	.9
Secchi (m)	.43	.05	.65
Temperature (°C)	18.6	5.5	32
Salinity (ppt)	16.7	1.2	27.2
pH	8	6.5	9
chlorophyll a (ug/l)	52.3	2.6	164.0
Nitrate/Nitrite (uM)	31.8	0	239.5
Ammonia (uM)	4.95	0	23.4
DIN (uM)			
PO ₄ (uM)	1.9	0	8.8

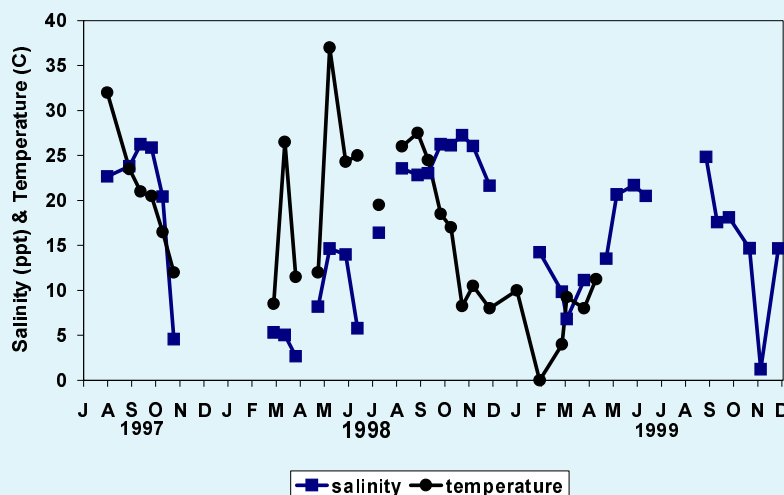
Station Characterization

The average depth of this station was 1.25 meters with a 1.3 meter observed water level range. This station exhibited a wide range of salinity levels from 1.2 up to 27 ppt with the lowest salinities in the early spring. The water temperature pattern can be generally described as a sinusoidal pattern of fluctuation. The low records for the year are in December through March and the peak in monthly mean temperature is July and August. The pH levels are generally in range for marine life.

Seagrass Criteria

CHLA exceeded habitat requirements in 1998 and 1999 with median values of 58 and 67 respectively. KD was borderline in 1998 due to small sample size but did not meet criteria in 1999 (me-

Station 11: Bishopville Boat Landing



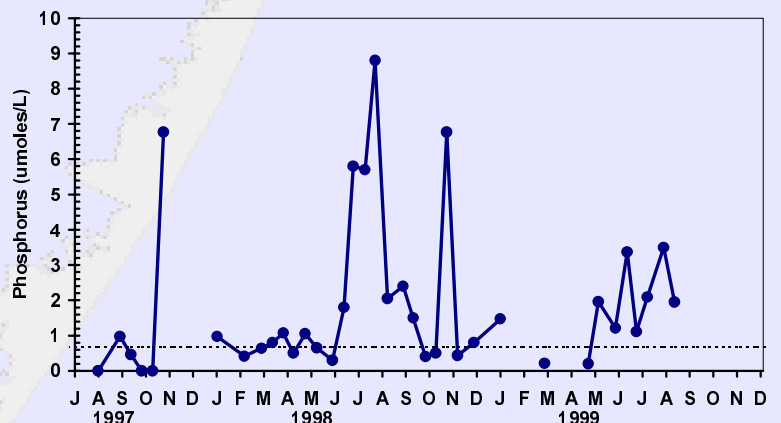
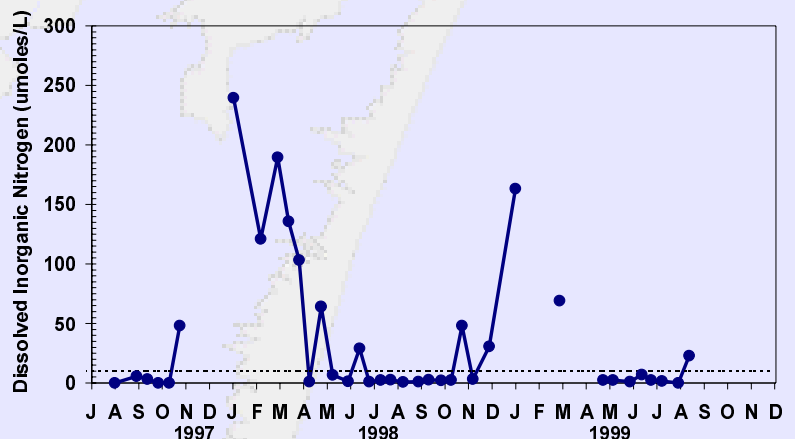
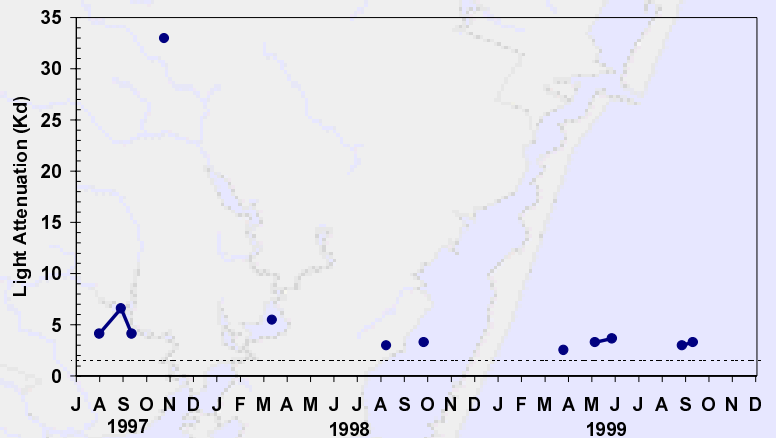
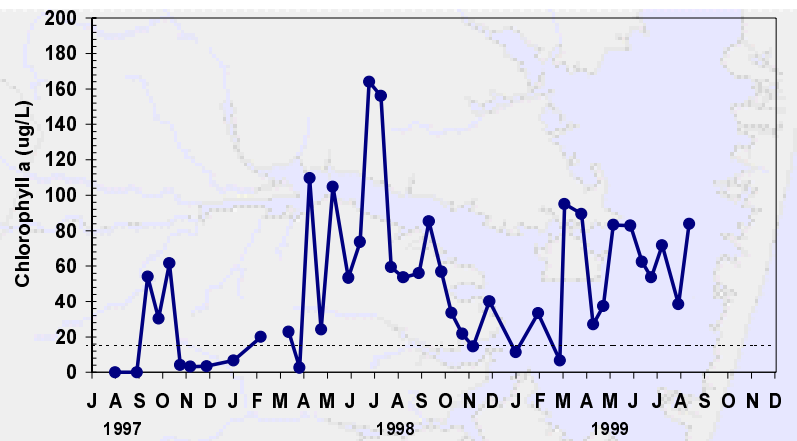


dian value of 3.11 and 3.3 respectively). The lack of data in 1998 was due to the secchi remaining visible on the bay bottom; hence, there was sufficient light at that station for seagrass growth and it is unclear if the overall area met the SAV requirement due to the mean depth of the station was less than 1 meter (the goal of the habitat requirement).

DIN and DIP habitat requirements were borderline both years with median values of 2.45 and 1.29 respectively in 1998; and 2.48 and 1.96 respectively in 1999. Although DIN medians did not exceed criteria, DIP medians exceeded criteria both years (criteria were exceeded 9/14 in 1998 and 7/8 in 1999).

Relationship to Other Data:

Relationship to Pfiesteria
BSP00xx.



Station 13 Holiday Harbor

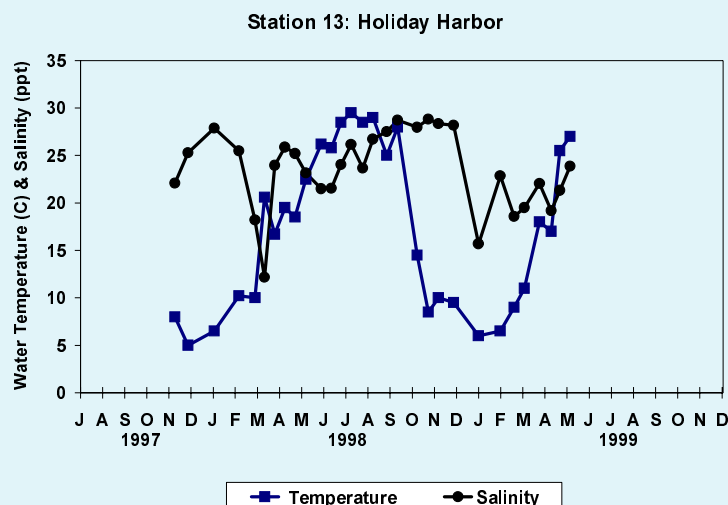
This station is in the St. Martin River segment (within the Isle of Wight watershed). This site has been monitored by Richard Mueller and Evelyn Adams since April 1998.



Parameter	Mean	Minimum	Maximum
Depth (m)	.59	.25	.85
Secchi (m)	.45	.3	.7
Temperature (°C)	17.35	5	29.5
Salinity (ppt)	23.5	12.2	28.8
pH	8.2	7.5	9.2
chlorophyll a (ug/l)	34.3	1.03	93.6

Station Characterization

The average depth of this station was 0.6 meters with a 0.6 meter observed water level range. This station exhibited generally stable polyhaline salinity levels between 12 and 29 ppt. The water temperature pattern is best described as a sinusoidal pattern of fluctuation throughout the year. The low records for the year are in December through March and the peak in monthly mean temperature is July and August. The pH levels are generally in range for marine life.





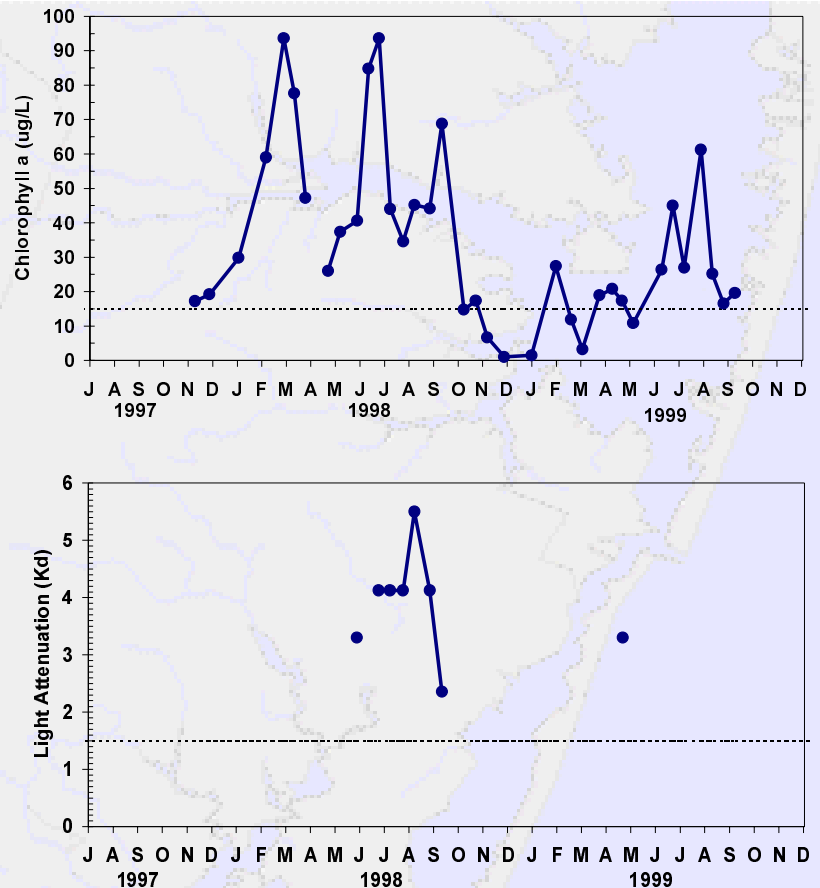
Seagrass Criteria

This station does not measure the DIN and DIP habitat requirements.

Chlorophyll a levels did not meet SAV habitat requirements in 1998 and 1999 (medians of 44.1 and 20.8 respectively). KD did not meet SAV habitat requirements in 1998 (median value of 4.13) and did not have enough data for statistical analysis in 1999. The lack of data was due to the secchi remaining visible on the bay bottom; hence, there was sufficient light at that station for seagrass growth. It can not be estimated if the area met the SAV requirement due to the mean station depth less than 1 meter (the goal of the habitat requirement).

Relationship to Other Data:

Relationship to DNR Pfiesteria station XDN4797.



Station 22 Piney Island-Shingle Landing

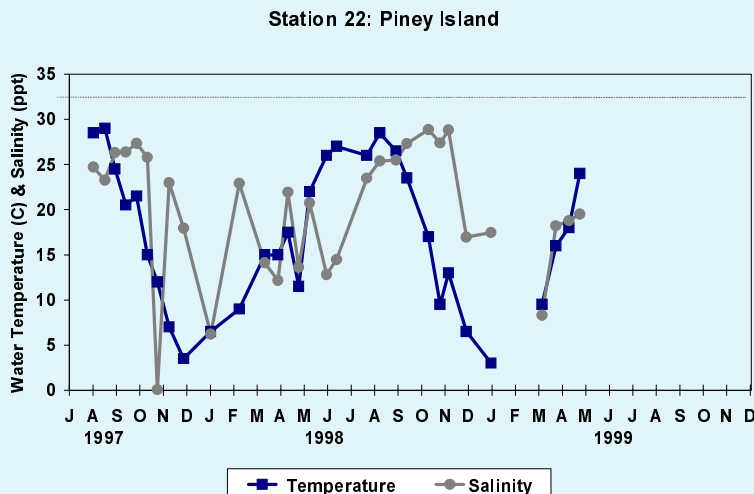
This station is in the St. Martin River segment (within the Isle of Wight watershed). There are no documented seagrass beds nearby. This station has been monitored by Marcy Oche since August 1997.



Parameter	Mean	Minimum	Maximum
Depth (m)	.56	.2	1.0
Secchi (m)	.39	.15	.65
Temperature (°C)	17.2	3	29
Salinity (ppt)	20.0	.07	28.9
pH	8.3	6.5	9
chlorophyll a (ug/l)	40.8	4.2	105.2
Nitrate/Nitrite (uM)	27.97	0	125.1
Ammonia (uM)	3.3	.7	11.3
DIN (uM)	36.7	.8	125.9
PO ₄ (uM)	.99	.21	5.9

Station Characterization

The average depth of this station was 0.6 meters with a 0.8 meter observed water level range. This station exhibited highly variable salinity levels between 0 and 29 ppt that may be related to observed water level. The water temperature pattern is best described as a sinusoidal pattern of fluctuation throughout the year. The low records for the year are in December through March and the peak in monthly mean temperature in August. The pH levels are generally in the range for marine life.





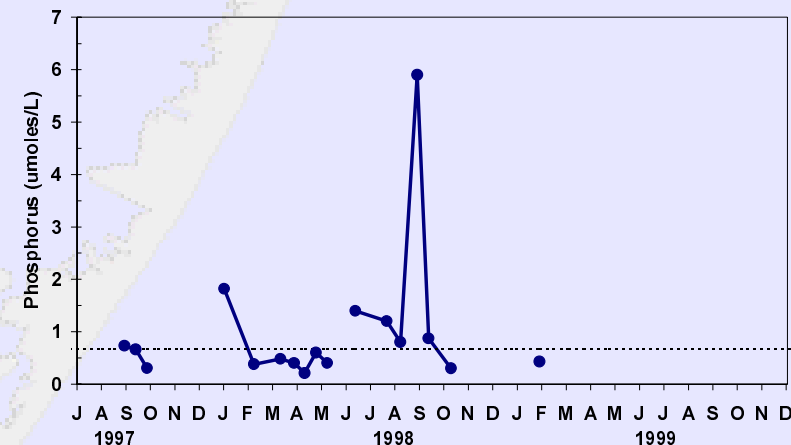
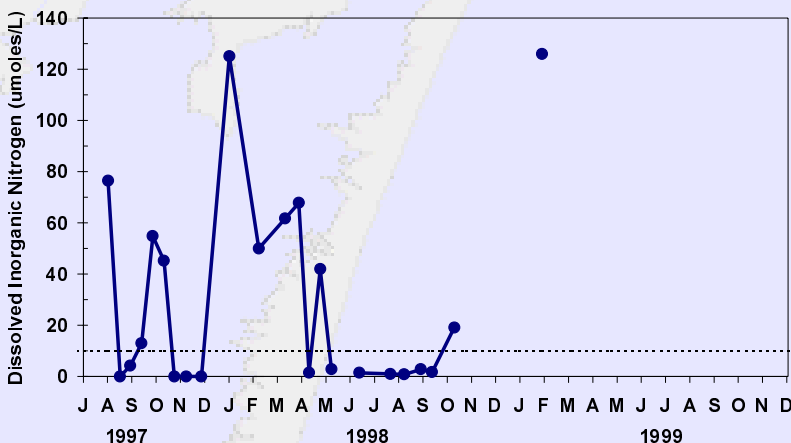
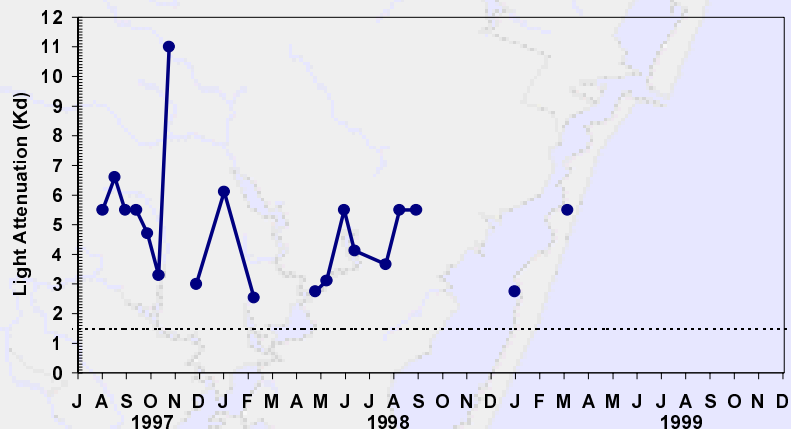
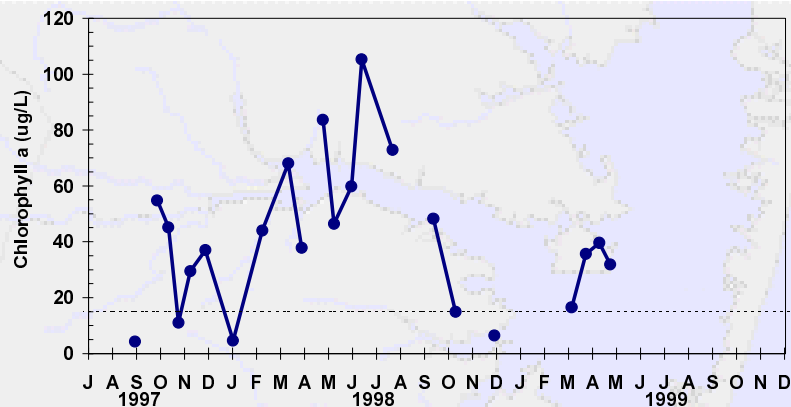
Seagrass Criteria

In 1998, DIN, DIP and CHLA were borderline. DIN and DIP medians (0.54 and 2.25 respectively) were below habitat requirements while CHLA median (47.31) was much higher than the requirement and exceeded requirements 8 out of 12 times. KD failed SAV habitat criteria (median = 4.13).

Not sufficient data to do analysis in 1999 (need a minimum of three sample dates spread out within SAV growing season). However, the CHLA median (35.6) for 3 samples in April and May exceeded the criteria.

Relationship to Other Data:

Relationship to Pfiesteria site# SPR009.





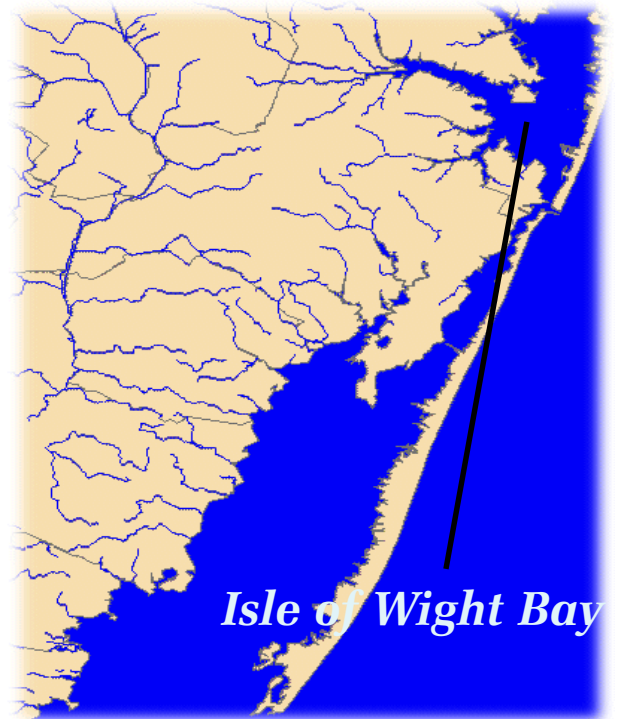
Isle of Wight Bay contained five stations.

Site 2 O.C. 36th St.

Site 5 O.C. Bluefish Cove

Site 6 Herring Creek

Site 30 Turville Creek



WATER QUALITY STATUS

Chlorophyll *a*

The annual mean chlorophyll value was 8.5 in 1997, 10.3 for 1998 and 11.8 for 1999.

The collection goal was met - 80% of chlorophyll samples were taken.

Chlorophyll *a* concentrations in Isle of Wight Bay were generally below the SAV habitat value of 15 ug/l. Station XX had the greatest range in values (only up to 40 ug/l).

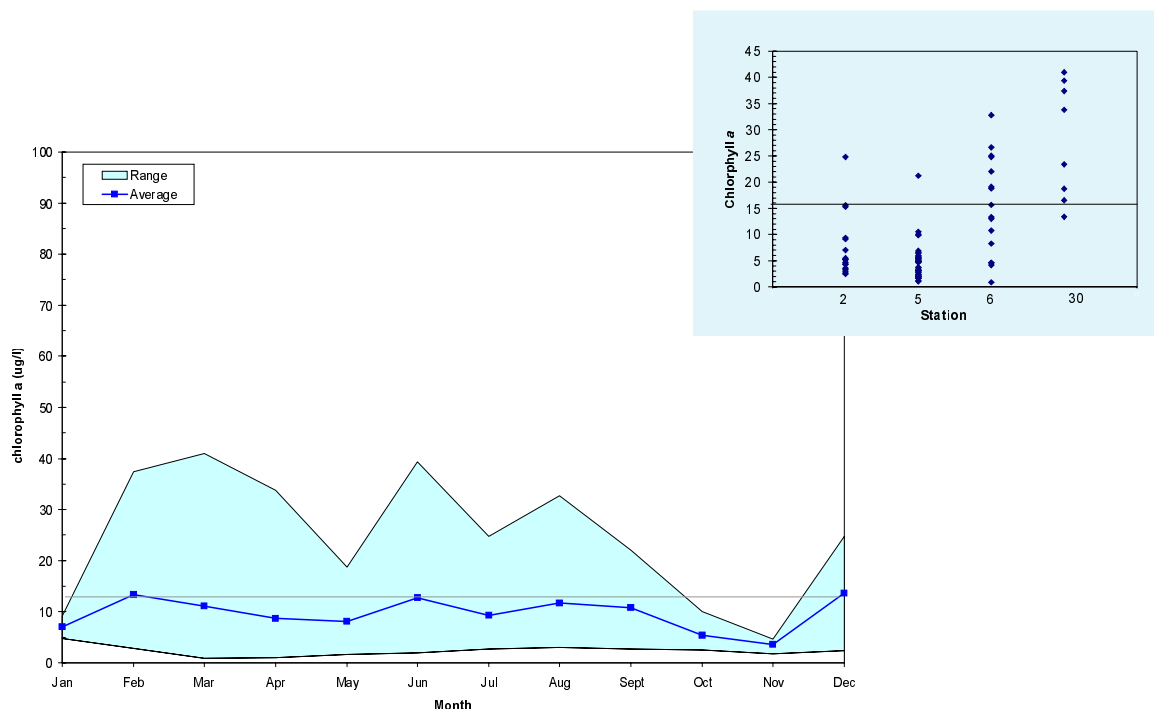


Figure XX: Monthly mean chlorophyll *a* concentrations in Assawoman Bay compared to range for 1997 - 1999. Insert graph shows chlorophyll *a* range by station.

Redfield Ratio (DIN:DIP)

Although the data is limited, redfield ratios show that Isle of Wight Bay may be nitrogen limited (e.g. phosphorus enriched at the molar level).

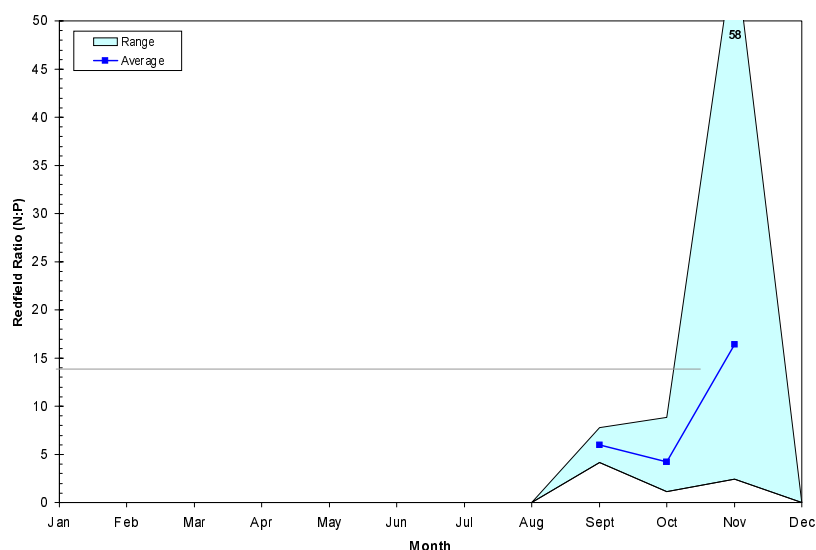
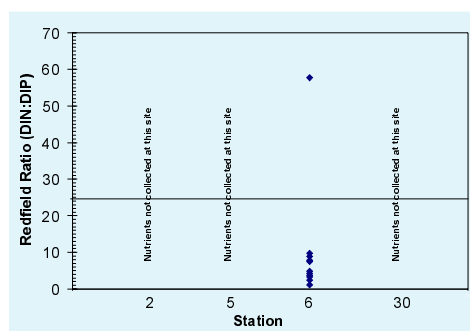


Figure XX: Monthly mean Redfield Ratios in Assawoman Bay compared to range for 1997 - 1999. Insert graph shows DIN:DIP range by station.

SEAGRASS HABITAT CONDITION



In 1998 100% of the SAV habitat requirements were met in Isle of Wight Bay while 91% were met in 1999. CHLA requirements were not met in 1999 at the Herring Creek station. DIN and DIP was attained at the Herring and Turville Creek stations (the only Isle of Wight Bay stations that measured these parameters) in 1999.

Site #	Location	1998	1999	TOTALS
2	O.C. 36 th st.	1/2	1/2	2/4
5	OC Bluefish cove	2/2	1/1	3/3
6	Herring Creek	NSD	2/4 (CHLA, KD)	2/4
30	Turville Creek	0/2 (CHLA, KD)	1/3 (CHLA)	1/5
TOTALS		3/6	5/10	8/16

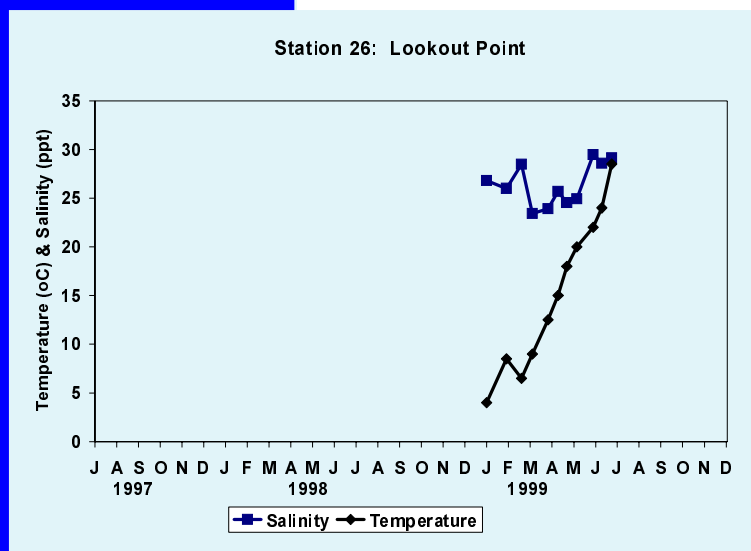
Station 26 Lookout Point

This station is located in the St. Martin River segment (within the Isle of Wight watershed). Preliminary data has shown new seagrass beds in this area in 1999.

Parameter	Mean	Minimum	Maximum
Depth (m)	1.32	1.0	1.6
Secchi (m)	.94	.4	1.4
Temperature (°C)	15.3	4.0	28.5
Salinity (ppt)	26.45	23.42	29.47
pH	8	7.8	8.5
chlorophyll a (ug/l)	20.32	5.79	38.2

Station Characterization

The average depth of this station was 1.3 meters with a 0.6 meter observed water level range. This station exhibited polyhaline salinity levels between 23 and 29 ppt. The low water temperature records for the year are in December and the peak monthly mean temperature measured was in June. The pH levels are in range for marine life.



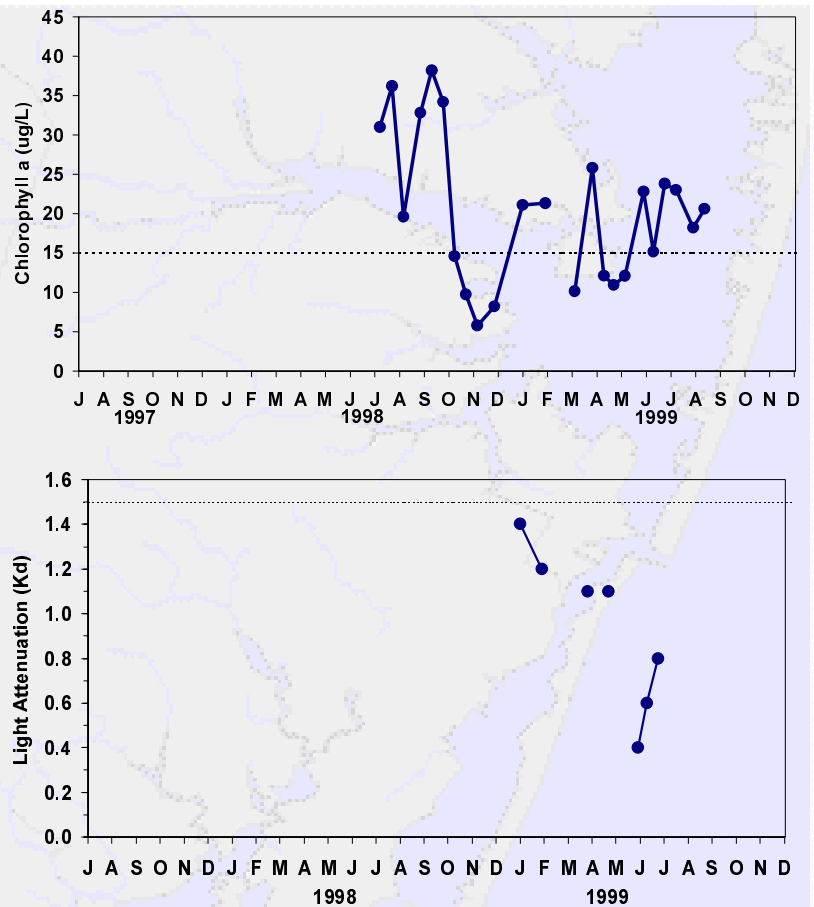
Seagrass Criteria

This station does not measure the DIN and DIP habitat requirements.

Chlorophyll a levels were borderline in 1998 and 1999 although medians (32.8 and 19.41 respectively) exceeded habitat requirements. KD was borderline in 1999 with a median value that did not meet criteria (median secchi of 2.06).

Relationship to Other Data:

DNR Pfiesteria XDN3527



Station 2 Ocean City, 36th Street

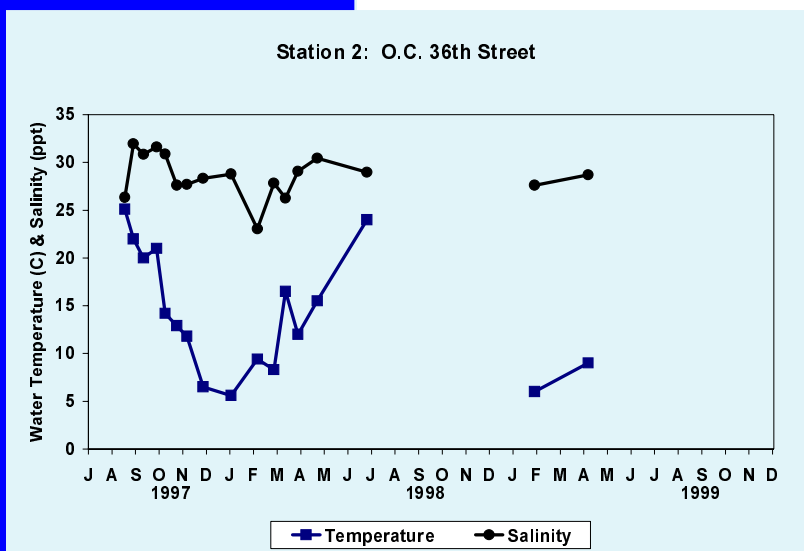
Station two is located in the Isle of Wight Bay watershed behind Ocean City. This station is just south of a large seagrass bed. There is no other similar data collected nearby. This site has been monitored by Mary Lou Loesh and Jeff Anderson since August 1997.



Parameter	Mean	Minimum	Maximum
Depth (m)	1.26	1.0	1.6
Secchi (m)	0.91	0.5	1.2
Temperature (°C)	14.11	5.6	25.1
Salinity (ppt)	28.6	23.1	32.0
pH	8.2	7.8	8.8
chlorophyll a (ug/l)	7.03	2.52	24.84

Station Characterization

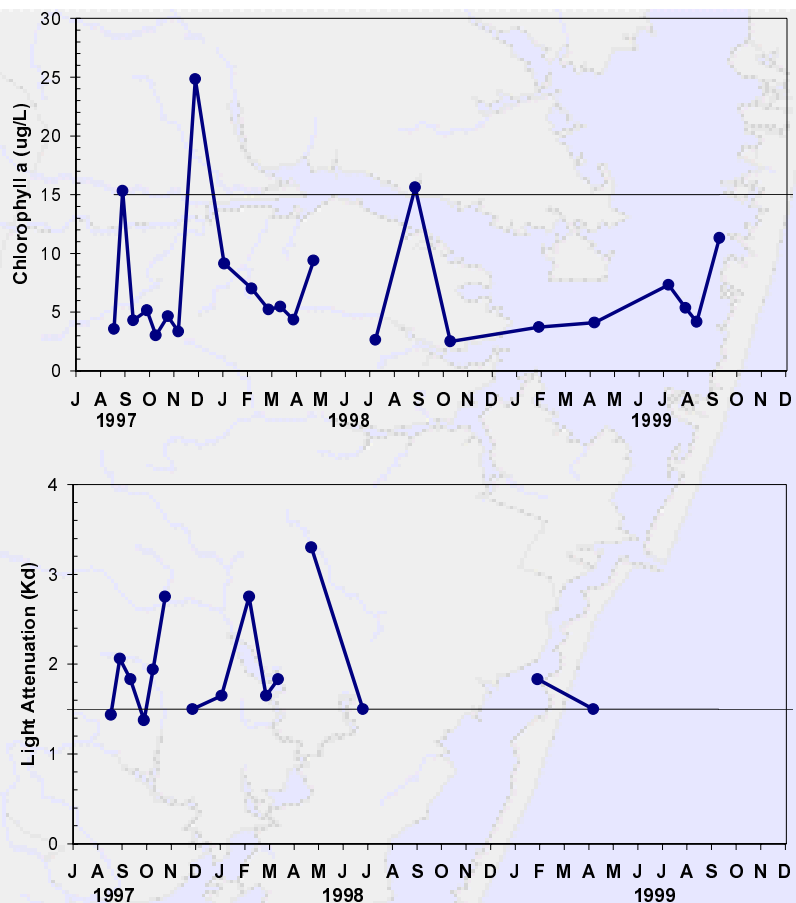
The average depth of this station was 1.3 meters with an approximate 0.6 meter observed water level range. This station exhibited polyhaline salinity levels generally between 25 and 30 ppt. The water temperature pattern indicates a sinusoidal pattern of fluctuation throughout the year. The low records for the year are in December through March and the peak in monthly mean temperature is July and August. The pH levels are in the acceptable range for marine life.



Seagrass Criteria

This station does not measure the DIN and DIP habitat requirements.

Chlorophyll a and KD criteria were borderline in 1998 and 1999. Median values for CHLA were below SAV habitat requirements most of the time (5 out of 6) during the growing season during 1998 and all of the time in 1999. Although KD not enough data points in 1998 or 1999 for statistical analysis, the data was borderline with a median equal to or exceeding habitat criteria. The lack of data was due to the secchi remaining visible on the bay bottom; hence, there was sufficient light at that station for seagrass growth. Furthermore, it can be estimated that the area met SAV requirements due to the mean depth of the station being greater than 1 meter (the goal of the habitat requirement).



Station 5

Ocean City, Bluefish Cove

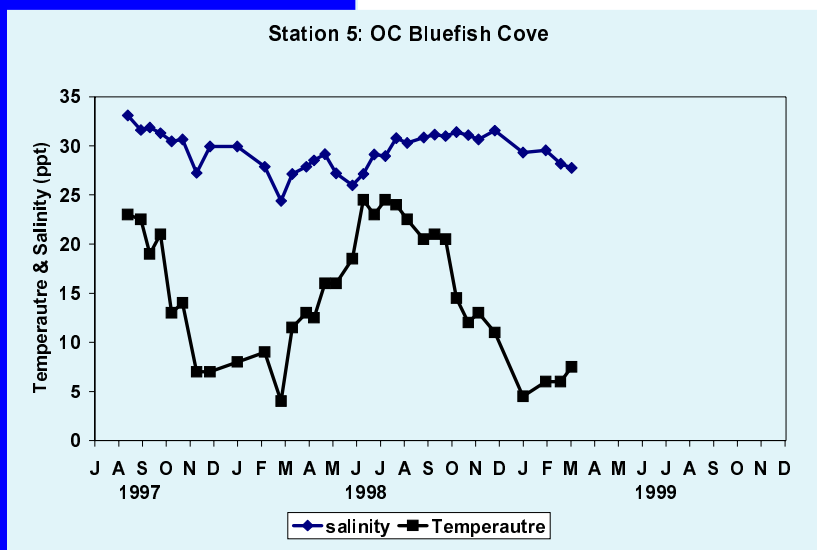
This station is located in the Isle of Wight Bay watershed, in a canal behind Ocean City. This station has been monitored by Jim Packer, Joe Ohara and Dee Rigby since August 1997. This station is not near a documented seagrass bed. There is no other similar data collected nearby.



Station Characterization

The average depth of this station was 1.91 meters with a 1.0 meter observed water level range. This station exhibited polyhaline salinity levels generally between 25 and 30 ppt. The water temperature pattern is best described as a sinusoidal pattern of fluctuation throughout the year. The low records for the year are in December through March and the peak in monthly mean temperature is June through August. The pH levels are generally in range for marine life.

Parameter	Mean	Minimum	Maximum
Depth (m)	1.91	1.40	2.40
Secchi (m)	1.17	.65	2.30
Temperature (°C)	14.85	4.0	24.5
Salinity (ppt)	29.49	24.39	33.11
pH	8	8	8
chlorophyll a (ug/l)	4.68	1.12	21.2

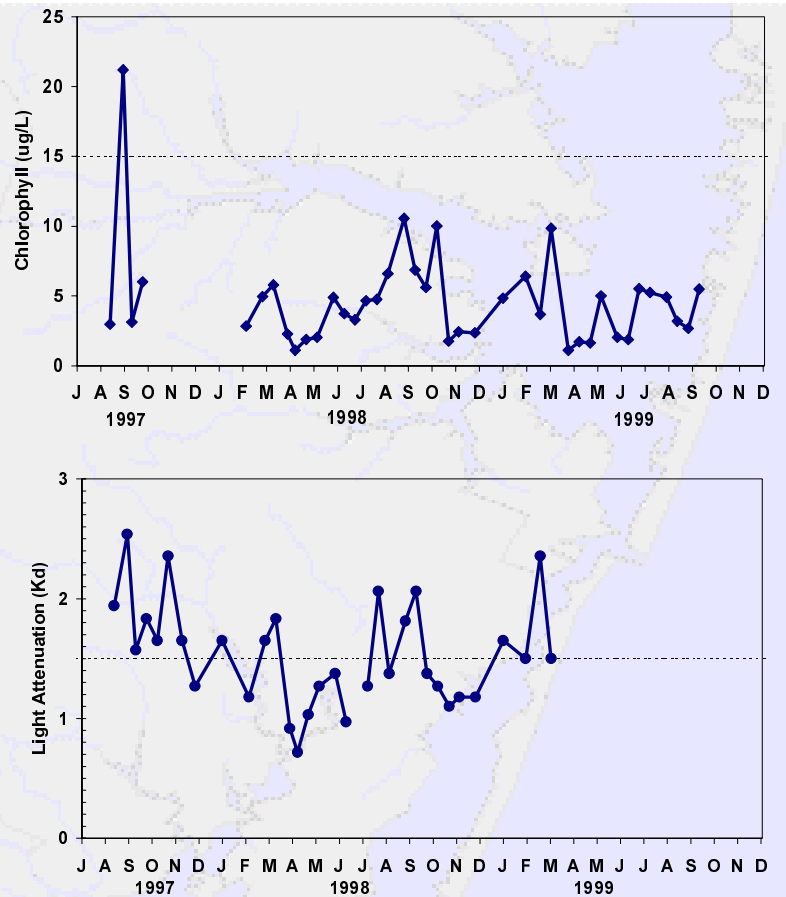




Seagrass Criteria

This station does not measure the DIN and DIP habitat requirements.

Chlorophyll a levels met SAV habitat requirements in 1998 (13/14) and 1999 (12/12) with a median values of 4.7 and 2.94 respectively. KD was border-line in 1998 (8/13) with a median of 1.34 but there were not enough data points in 1999 for statistical analysis. The lack of data in 1999 was due to the secchi remaining visible on the bay bottom; hence, there was sufficient light at that station for seagrass growth. Furthermore, it can be estimated that the area met SAV requirements due to the mean depth of the station being greater than 1 meter (the goal of the habitat requirement).



Station 6

Herring Creek

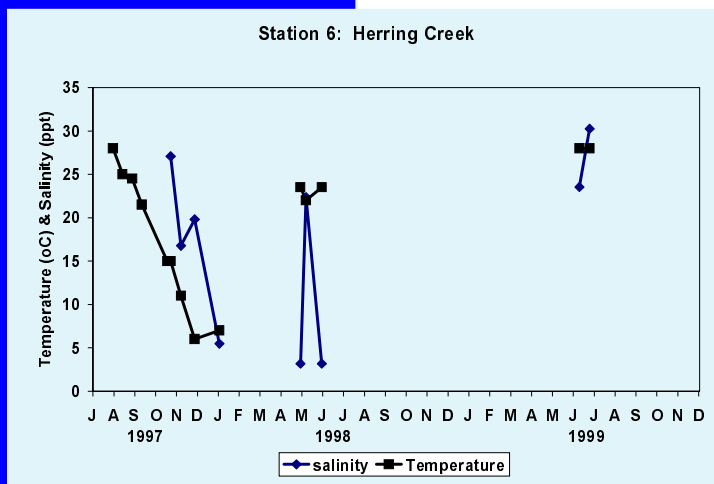
This station is located in the Isle of Wight subwatershed. This station changed locations during 1998 which probably accounts for the large shift in salinities. Not near any documented seagrass beds. Although DNR monitors this creek, there is no other similar data collected nearby. This station was monitored by Tom and Tina Crooper.



Station Characterization

The average depth of this station was 1.0 meters with a 0.7 meter observed water level range. This station had widely variable salinities with the highest salinities in the summer and the lowest in the late winter/ early spring. Water temperature low records were recorded in December and January and the peak in monthly mean temperature is July and August. The pH levels are generally in range for marine life.

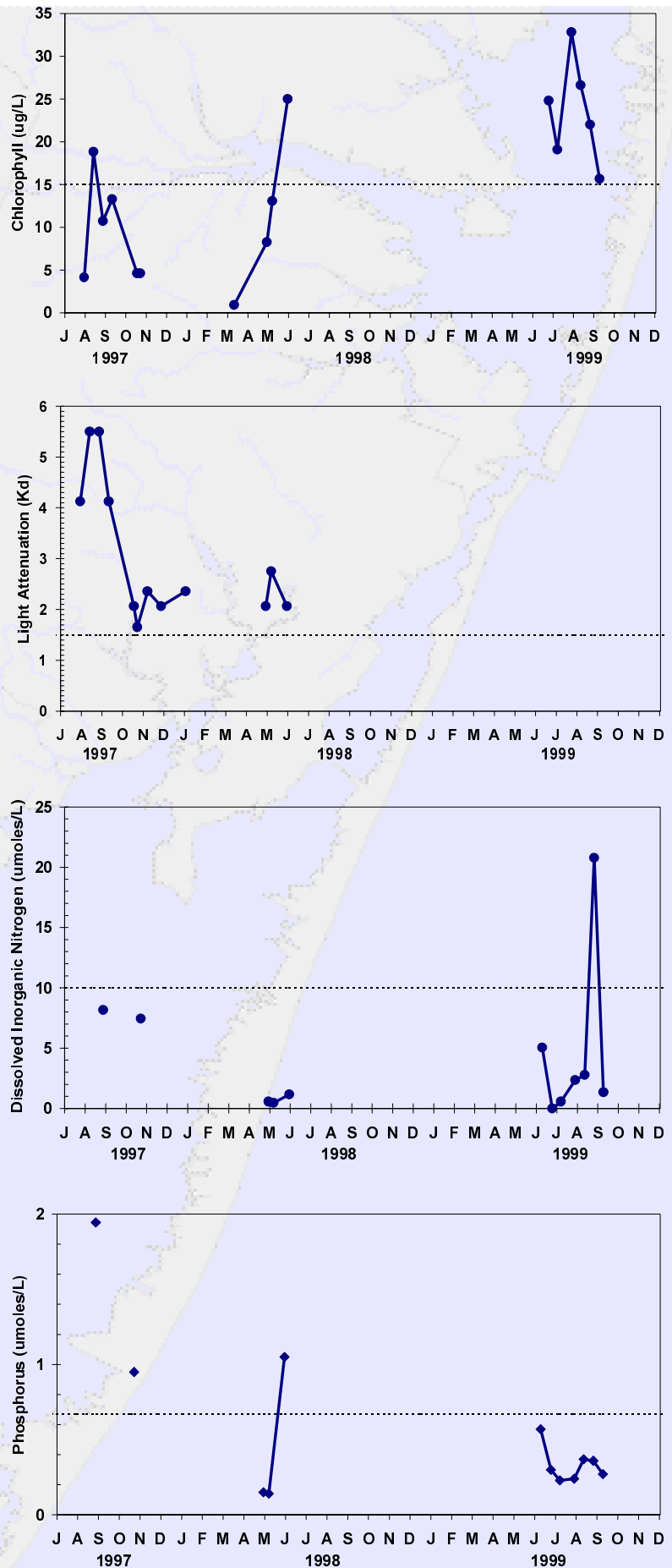
Parameter	Mean	Minimum	Maximum
Depth (m)	1.0	.60	1.30
Secchi (m)	.61	.30	1.0
Temperature (°C)	19.86	6.0	28.0
Salinity (ppt)	16.85	3.17	30.27
pH	7.7	7	8.5
chlorophyll a (ug/l)	15.27	.91	32.8
Nitrate/Nitrite (uM)	1.11	.24	4.40
Ammonia (uM)	4.18	.24	19.17
DIN (uM)	4.60	.46	20.77
PO ₄ (uM)	.55	.14	1.94



Seagrass Criteria

Not sufficient data in 1998 for statistical analysis; however, median concentrations were below criteria except KD.

In 1999, 3 out of the 4 habitat requirements were met. Chlorophyll a was not met with a median of 23.4. Although the median for DIN was 2.56, it was borderline at the $p=0.05$ level. DIP levels met SAV habitat requirements most of the time during the growing season (median value = 0.3). KD was borderline with a median value of 3.3; however, there were not enough data points in 1999 for statistical analysis. The lack of data was due to the secchi remaining visible on the bay bottom; hence, there was sufficient light at that station for seagrass growth and it can be estimated that the area met the SAV requirement due to the mean depth of the station being 1 meter (the goal of the habitat requirement).



Station 4

Green Creek

This station is located in the Sinepuxent Bay watershed. It is near SAV beds growing in Sinepuxent Bay. There is no other similar data being collected nearby. This station was monitored by Chris Wade and Hollis Martin between August 1997 and 1998.

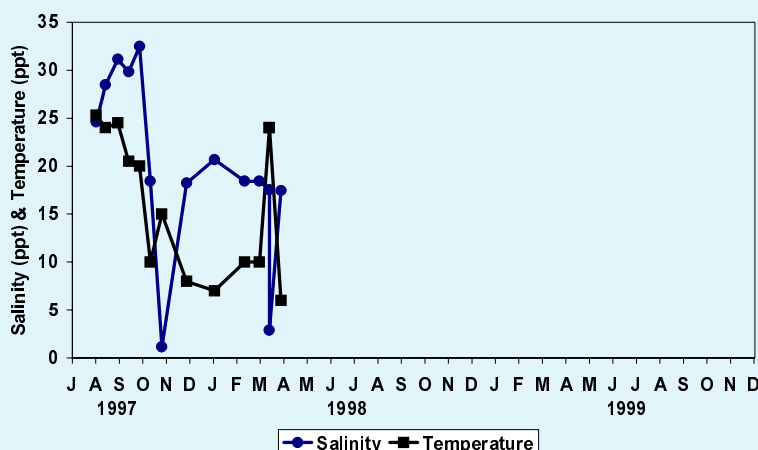


Parameter	Mean	Minimum	Maximum
Depth (m)	.64	.30	.80
Secchi (m)	.61	.41	.80
Temperature (°C)	16.31	6.0	25.3
Salinity (ppt)	19.98	1.14	32.46
pH	8	7.3	8.8
chlorophyll a (ug/l)	21.0	5.8	61.2
Nitrate/Nitrite (uM)	3.39	1.44	9.12
Ammonia (uM)	6.53	3.64	9.86
DIN (uM)	6.65	1.74	13.74
PO ₄ (uM)	.49	.21	.85

Station Characterization

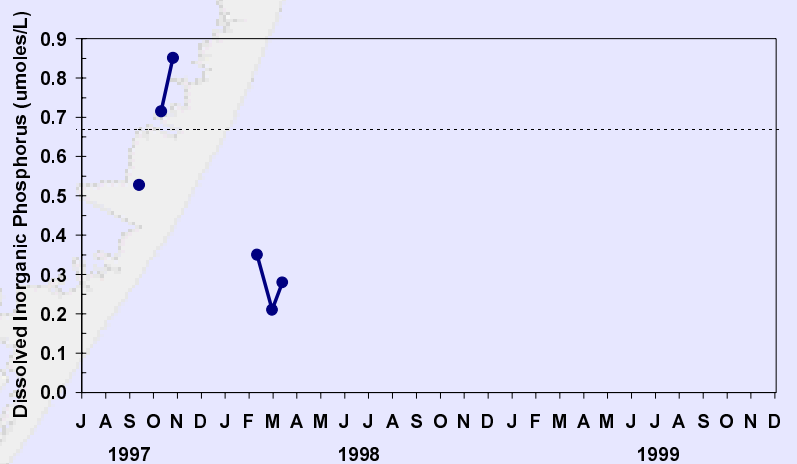
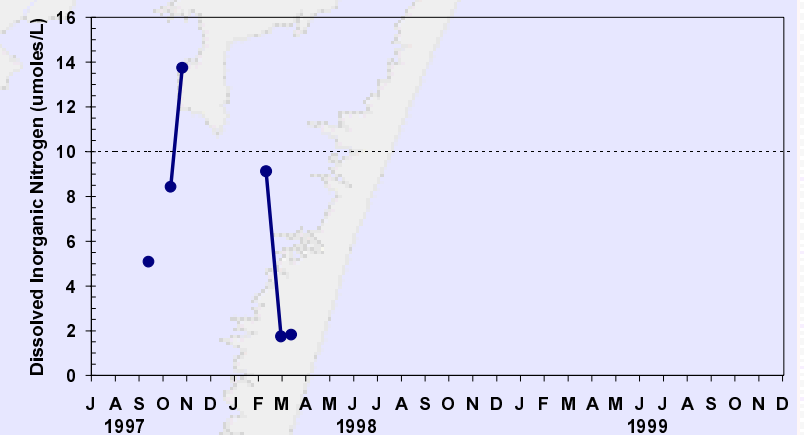
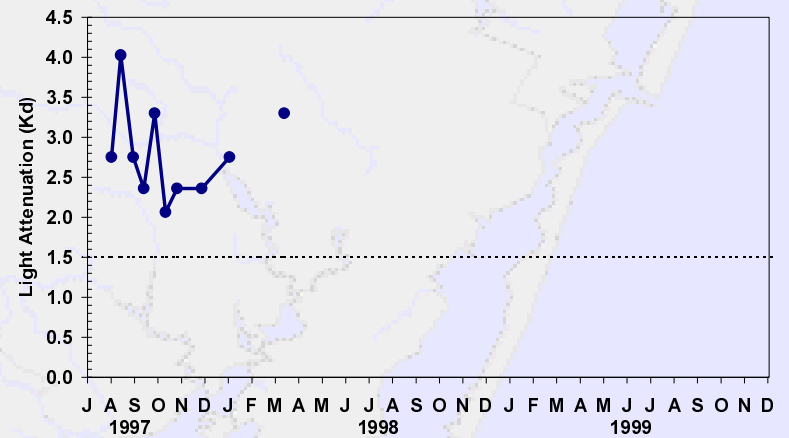
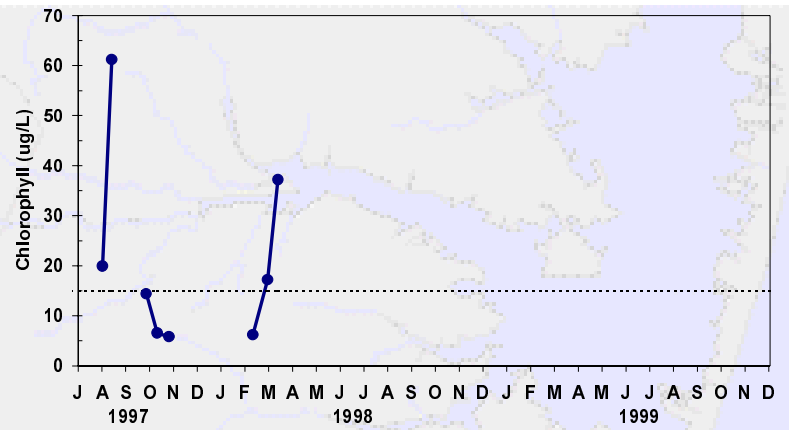
The average depth of this station was 0.64 meters with a 0.5 meter observed water level range. This station exhibited polyhaline salinity levels between 18 and 30 ppt with the lowest salinities in the late fall and early spring. The water temperature pattern can be described as a sinusoidal pattern of fluctuation with the low records for the year are in December through March and the peak in monthly mean temperature is July and August. The pH levels are generally in range for marine life.

Station 4: Green Creek



Seagrass Criteria

Not sufficient data to do analysis
(need a minimum of three sample
dates spread out within SAV growing
season).



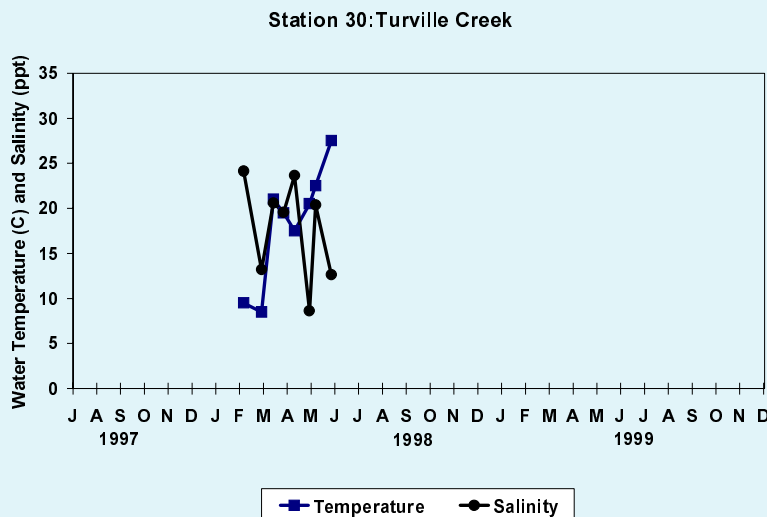
Station 30 Turville Creek

This station is in the Isle of Wight watershed. No documented seagrass beds are nearby. This site was monitored by Tom and Tina Crooper between June 1998 and March 1999.

Parameter	Mean	Minimum	Maximum
Depth (m)	.7	.3	1.5
Secchi (m)	.47	.3	.6
Temperature (°C)	20.26	8.5	30.1
Salinity (ppt)	20.1	8.6	29.5
pH	8.1	7	9
chlorophyll a (ug/l)	28.42	13.36	41.0
Nitrate/Nitrite (uM)	.76	.18	3.23
Ammonia (uM)	3.78	.68	5.85
DIN (uM)	4.54	3.52	6.03
PO ₄ (uM)	.5	.27	.71

Station Characterization

The average depth of this station was 0.7 meters with a 1.2 meter observed water level range. This station exhibited a wide range in salinity levels between 9 and 30 ppt. The pH levels are in range for marine life.



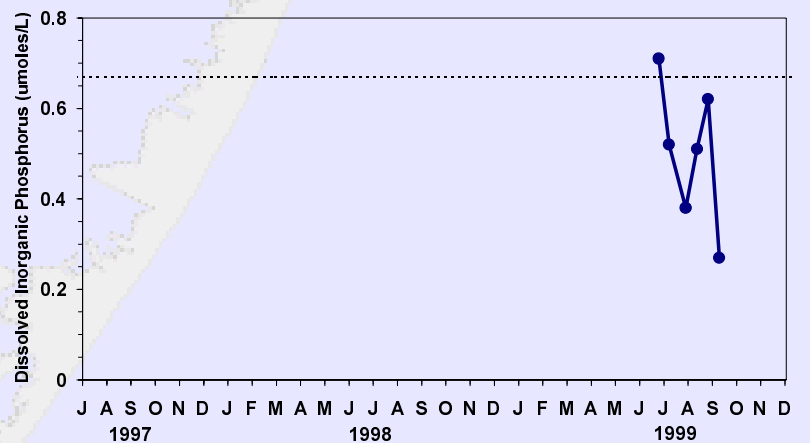
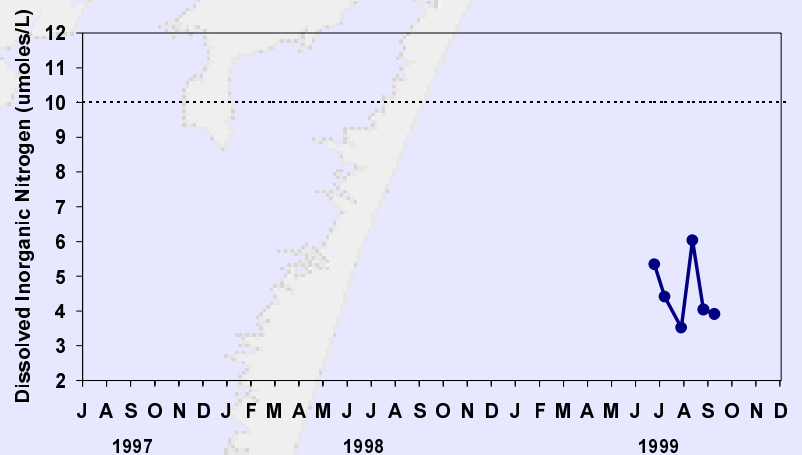
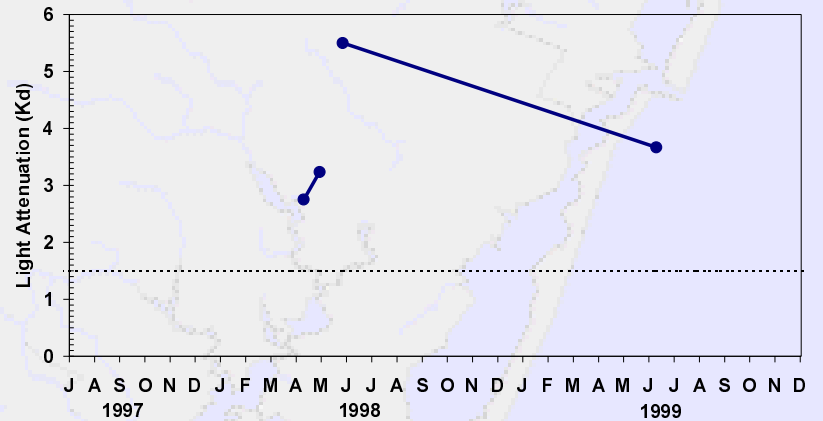
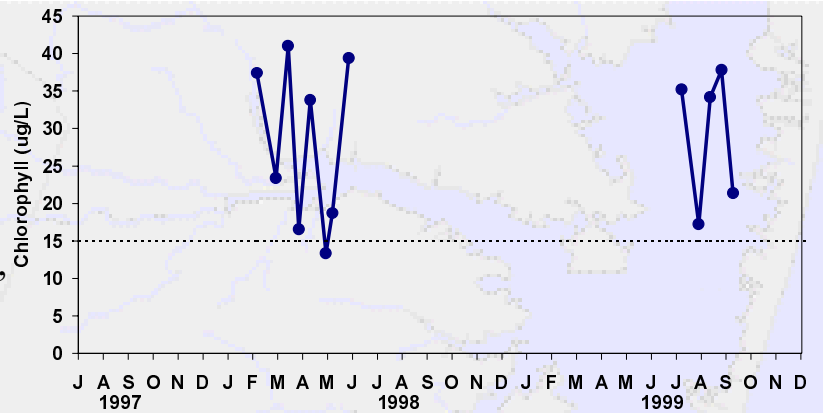
Seagrass Criteria

This station did not measure DIN and DIP habitat requirements in 1998. In 1998, CHLA and KD were borderline, although both medians (23.4 and 3.24 respectively) did not meet SAV habitat requirements.

In 1999, DIP, CHLA and KD were borderline, although CHLA and KD medians (34.2 and 3.44 respectively) did not meet SAV habitat requirements. DIN met habitat requirements in 1999.

Relationship to Other Data:

Relationship to DNR Pfiesteria station TUV0019.



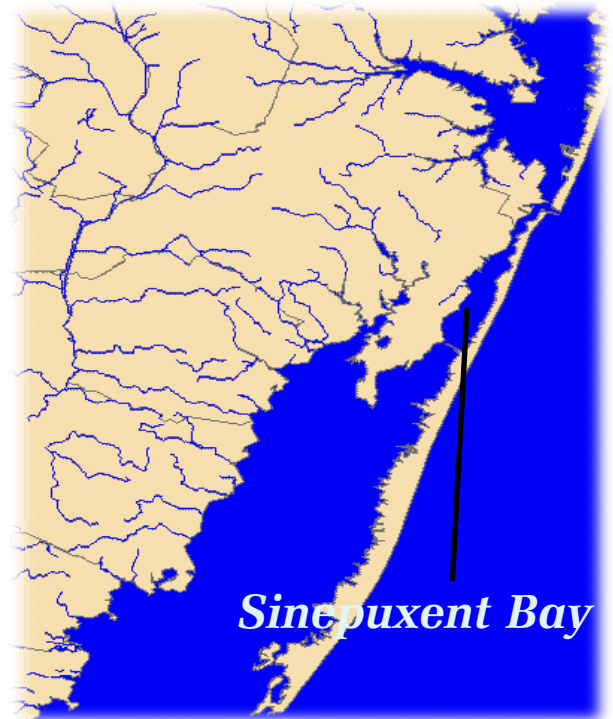


Sinepuxent Bay had three monitoring stations.

Site 8 South Point

Site 7 Rum Pt. Pier

Site 31 South Snug Harbor



Sinepuxent Bay

WATER QUALITY STATUS

Chlorophyll *a*

The annual mean chlorophyll value was 9.0 in 1997, 9.4 for 1998 and 6.8 for 1999.

The collection goal was met - 83.2% of chlorophyll samples were taken.

Chlorophyll *a* concentrations in Sinepuxent Bay were generally below the SAV habitat value of 15 ug/l except in June, July and August. Peak chlorophyll concentrations were in July/August. Station 8 had the greatest range in values (only up to 47 ug/l).

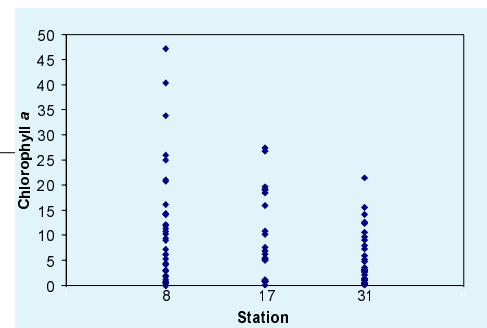
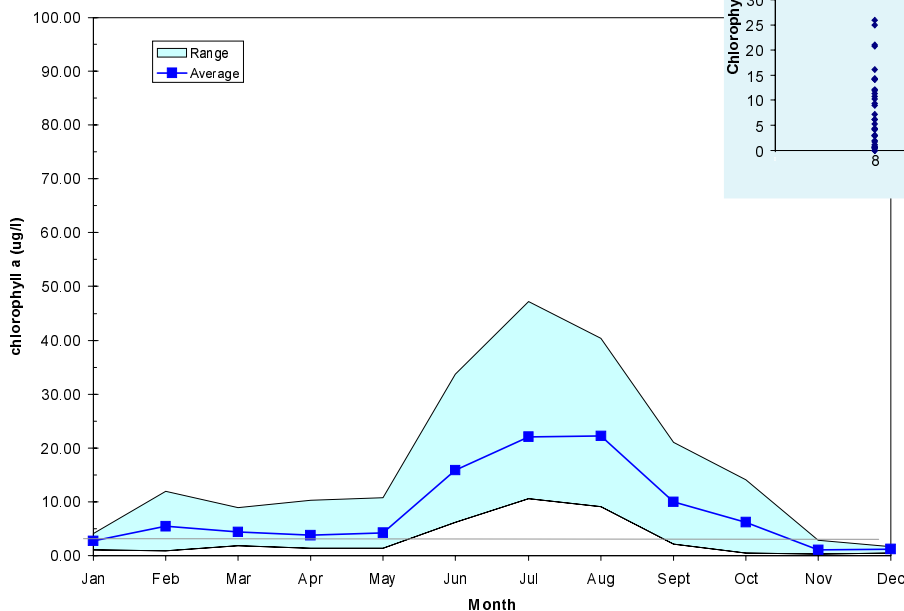


Figure XX: Monthly mean chlorophyll *a* concentrations in Assawoman Bay compared to range for 1997 - 1999. Insert graph shows chlorophyll *a* range by station.

Redfield Ratio (DIN:DIP)

Although the data is limited, redfield ratios show that Sinepuxent Bay may be nitrogen limited (e.g. phosphorus enriched at the molar level).

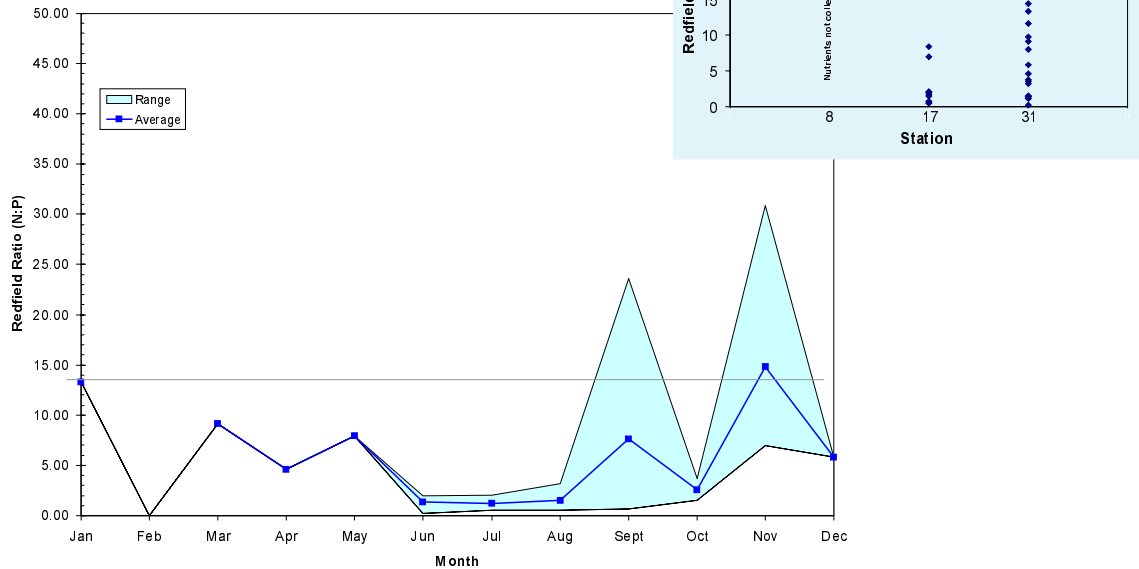


Figure XX: Monthly mean Redfield Ratios in Assawoman Bay compared to range for 1997 - 1999. Insert graph shows DIN:DIP range by station.

SEAGRASS HABITAT CONDITIONS

In 1998 60% of the SAV habitat requirements were met in Sinepuxent Bay while 50% were met in 1999. Station 31, south snug harbor, failed DIP requirements in 1999 (the only station other than Trappe Creek in Newport Bay to fail a nutrient criteria).

Site #	Location	1998	1999	TOTALS
8	South Point	0/2 (CHLA, KD)	2/2 (KD)	2/4
10	South Point Lndg	ND	NSD	0
17	Rum Pt. Pier	3/4 (KD)	ND	3/4
21	Assateague -ferry	ND	ND	0
31	South snug harbor	4/4	2/4 (KD, DIP)	6/8
TOTALS		7/10	4/6	11/16

Station 8

South Point

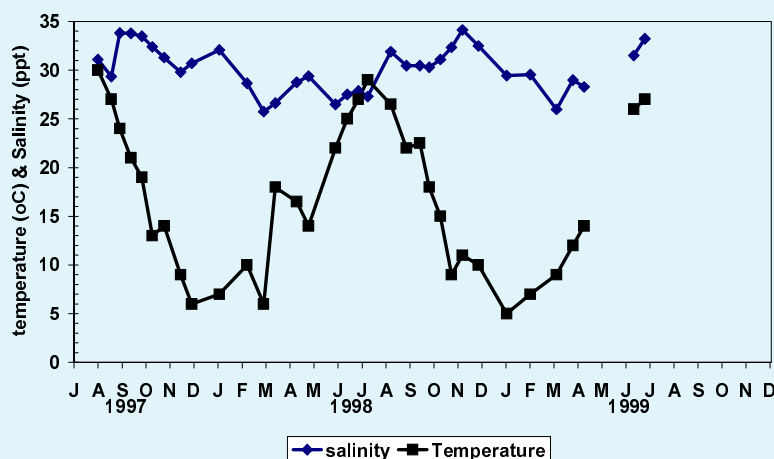
This station is in the Sinepuxent Bay watershed. It has been collecting data since 1997 and has an extremely good record. This station is not near any documented seagrass beds. This station has been monitored by Mike and Beverly Arentz since August 1997.

Station Characterization

The average depth of this station was 1.6 meters with a 1.5 meter observed water level range. This station exhibited stable polyhaline salinity levels between 30 and 34 ppt. The water temperature pattern is best described as a sinusoidal pattern of fluctuation throughout the year. The low records for the year are in December through March and the peak in monthly mean temperature is July and August. The pH levels are generally in range for marine life.

Parameter	Mean	Minimum	Maximum
Depth (m)	1.62	.71	2.20
Secchi (m)	.87	.30	1.8
Temperature (°C)	16.81	5.0	30.0
Salinity (ppt)	30.18	25.75	34.12
pH	8	7.9	9
chlorophyll a (ug/l)	11.71	.61	47.2

Station 8: South Point





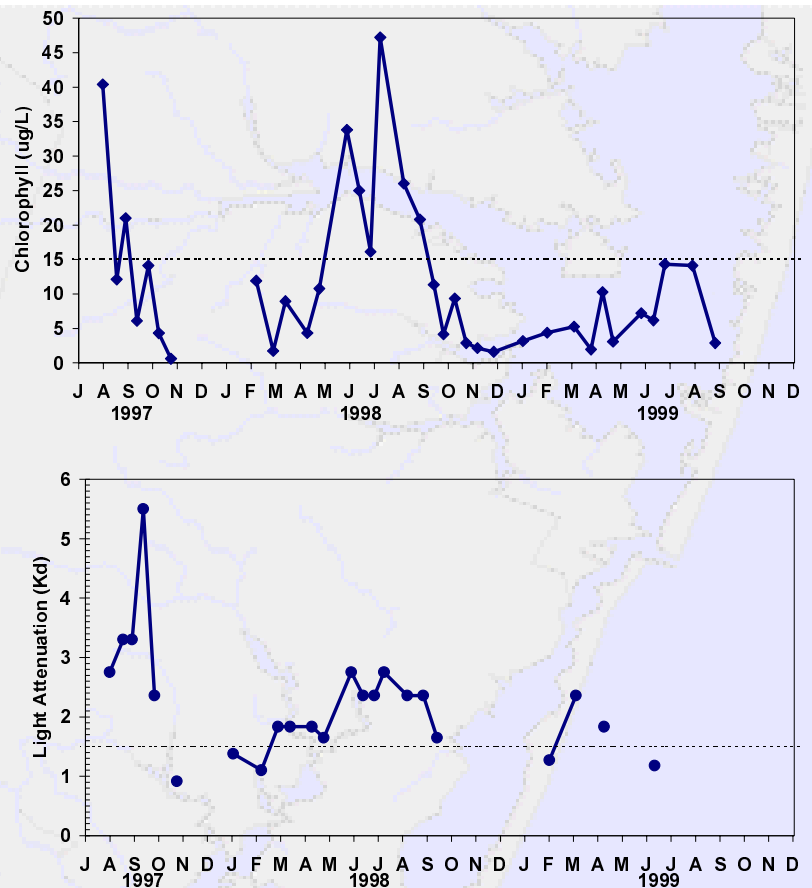
Seagrass Criteria

This station does not measure the DIN and DIP habitat requirements.

Chlorophyll a and KD were borderline in 1998 with median values (16.12 and 2.36 respectfully) that did not meet requirements. Chlorophyll a met requirements 5/11 times and KD 7/9. In 1999, chlorophyll a met habitat requirements (median = 6.69) and KD was borderline (median = 1.83) due to a small sample size. The lack of data was due to the secchi remaining visible on the bay bottom; hence, there was sufficient light at that station for seagrass growth and it can be estimated that the area met the SAV requirement due to the mean depth of the station being greater than 1 meter (the goal of the habitat requirement).

Relationship to Other Data:

Relationship to National Park Service data for station 16.



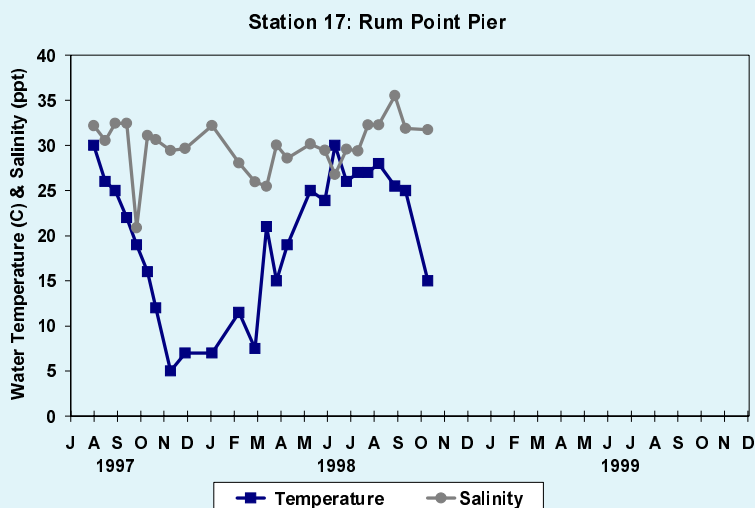
Station 17 Rum Point Pier

This station is in Sinepuxent Bay watershed. This station is within a seagrass bed and near another large seagrass bed behind Assateague Island. This station is also near ASIS station 18. Janet Cherrix has monitored this station since August 1998.

Parameter	Mean	Minimum	Maximum
Depth (m)	0.9	.6	1.5
Secchi (m)	1.1	.4	6
Temperature (°C)	19.8	5	30
Salinity (ppt)	30	20.9	35.5
pH	8.2	6.5	8.5
chlorophyll a (ug/l)	9.3	.1	27.4
Nitrate/Nitrite (uM)	.7	0	3.6
Ammonia (uM)	1.2	.4	3.2
DIN (uM)	1.6	.5	4.5
PO ₄ (uM)	.7	.1	1.5

Station Characterization

The average depth of this station was 0.9 meters with a 0.9 meter observed water level range. This station exhibited polyhaline salinity levels between 21 and 36 ppt. The water temperature pattern is best described as a sinusoidal pattern of fluctuation throughout the year. The low records for the year are in December and January with peak temperatures in the summer. The pH levels are generally in range for marine life.



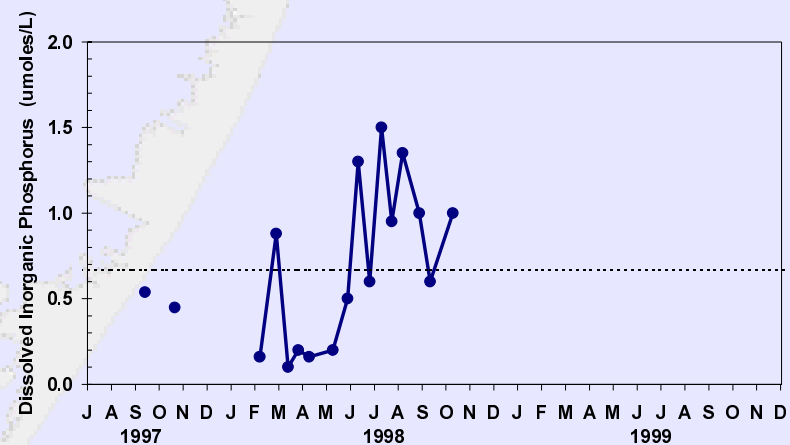
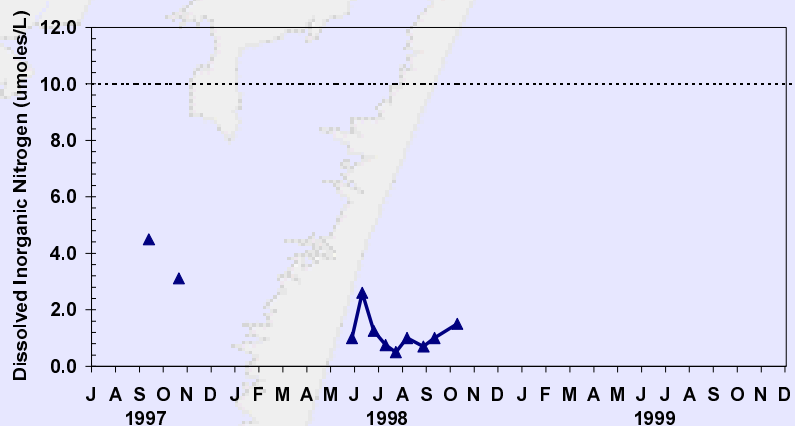
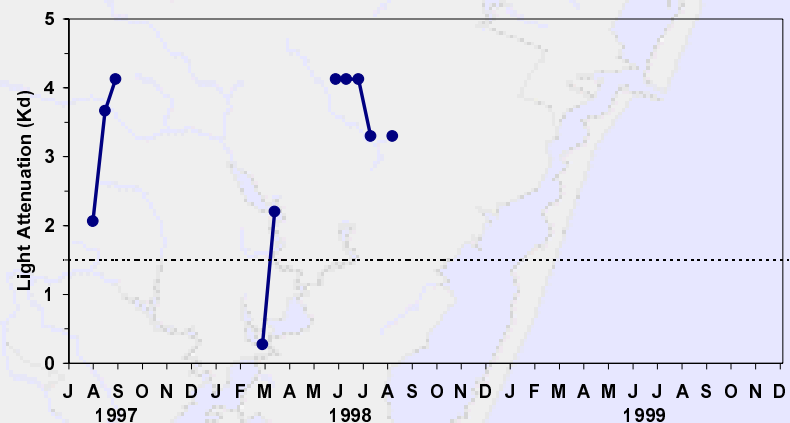
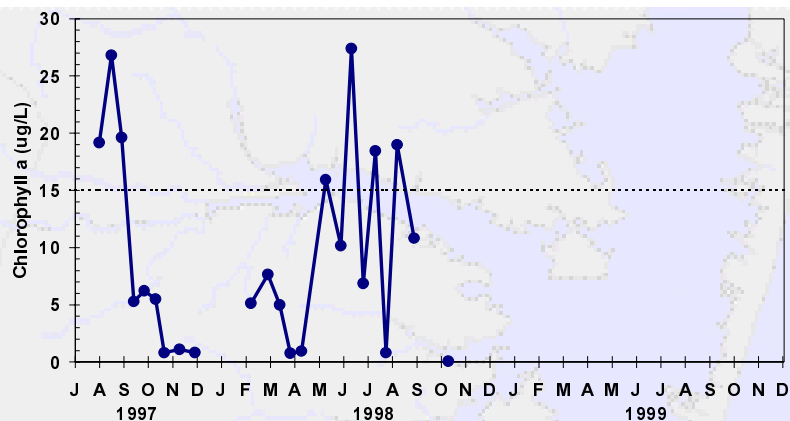
Seagrass Criteria

In 1998, DIN met SAV habitat requirements (median = 1) and KD did not meet criteria (median = 3.67). DIP and CHLA were borderline with medians (0.6 and 10.16 respectively) that were within habitat requirements.

No data was collected in 1999.

Relationship to Other Data:

Relationship to National Park Service data for station 18.



Station 31 South Snug Harbor

This station is in the Sinepuxent Bay watershed. It has been sampled since August 1997 providing a good record of water quality. This station has been monitored by Joe Smith and Tom Patton since August 1997.

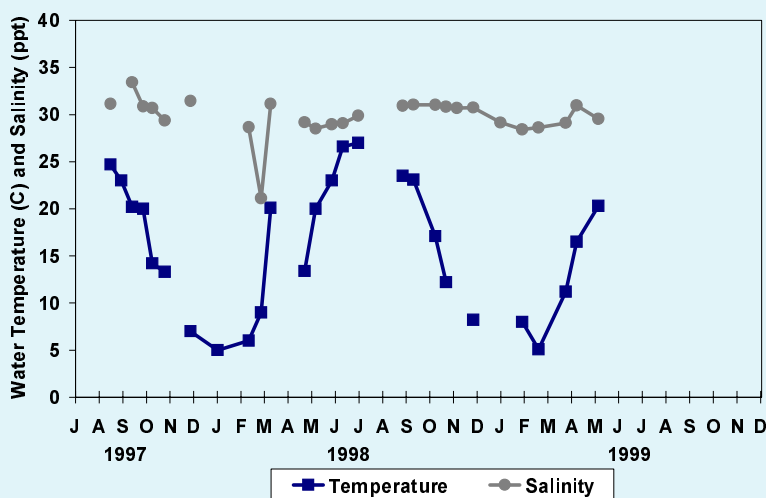


Parameter	Mean	Minimum	Maximum
Depth (m)	1.18	.95	1.5
Secchi (m)	.83	.42	1.4
Temperature (°C)	16.07	5.0	27.0
Salinity (ppt)	29.79	21.13	33.44
pH	8.2	7.9	8.7
chlorophyll a (ug/l)	5.18	.31	21.4
Nitrate/Nitrite (uM)	1.84	0	9.4
Ammonia (uM)	5.41	.1	25.65
DIN (uM)	5.73	0	34.67
PO ₄ (uM)	.69	.13	1.8

Station Characterization

The average depth of this station was 1.2 meters with a approximate 0.5 meter observed water level range. This station exhibited polyhaline salinity levels between 21 and 33 ppt with minimal fluctuation. The water temperature pattern is best described as a sinusoidal pattern of fluctuation. The low records for the year are in December through March and the peak in monthly mean temperature is July and August. The pH levels are in range for marine life.

Station 31: Snug Harbor



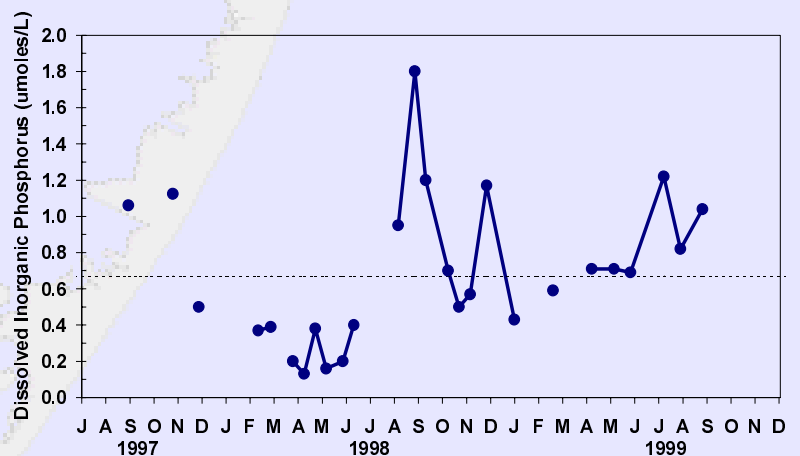
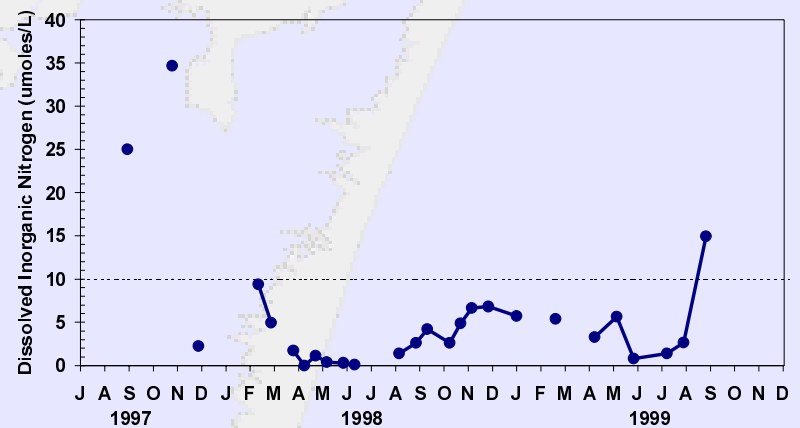
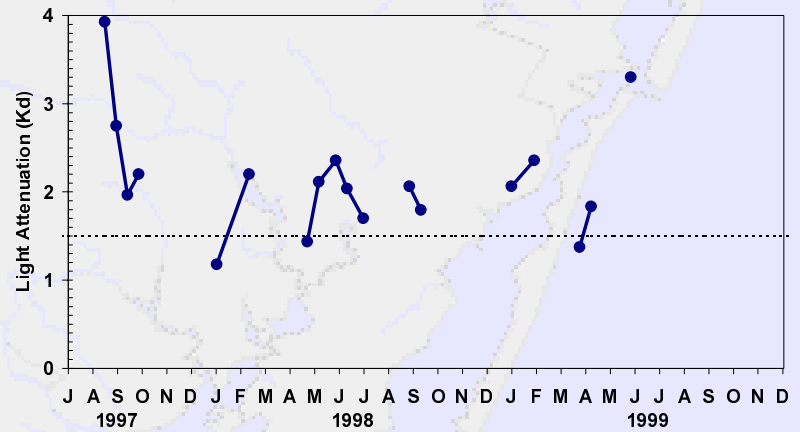
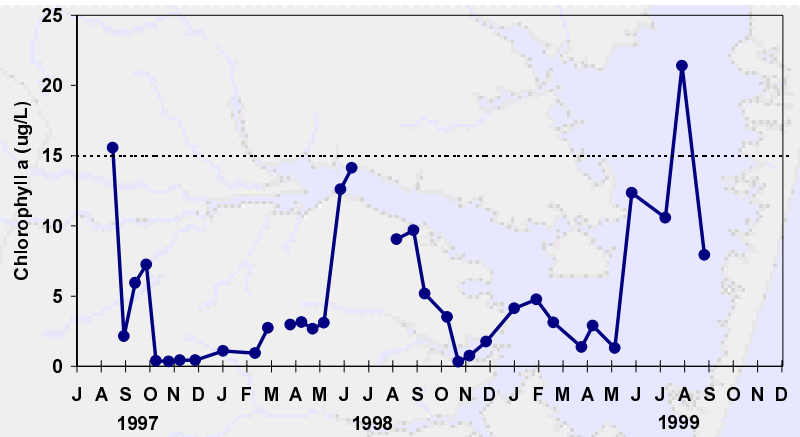
Seagrass Criteria

In 1998, DIN and CHLA were met and DIP and KD were borderline. DIP median (0.39) was below habitat criteria while the KD (2.04) median did not meet habitat requirements.

In 1999, DIP did not meet SAV habitat criteria (median = 0.77) and DIN, CHLA and KD were borderline. DIN met criteria 4 out of 5 samples with a median (2.95) below criteria. CHLA met criteria 6 out of 7 samples with a median (7.94) below criteria. However, KD failed 2 out of 3 samples with a median (1.83) that did not meet habitat requirements.

Relationship to Other Data:

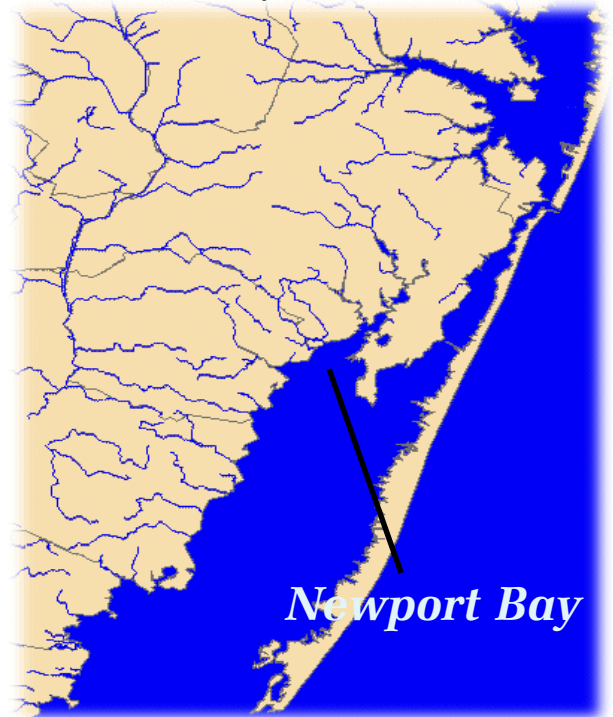
Relationship to National Park Service data for stations 1 and 17.





Newport Bay included four stations.

- Site 12 Mason Landing
- Site 15 O.C. Golf Course
- Site 23 Trappe Creek
- Site 33 Ayres Creek



Water Quality Status

Chlorophyll *a*

The annual mean chlorophyll value was 37.6 in 1997, 44.7 for 1998 and 27.0 for 1999.

The collection goal was met - 84.9% of chlorophyll samples were taken.

Chlorophyll *a* concentrations in Newport Bay were generally above the SAV habitat value of 15 ug/l. Peak chlorophyll concentrations were in May and July/August. Station 12 had the greatest range in values (only up to 240ug/l).

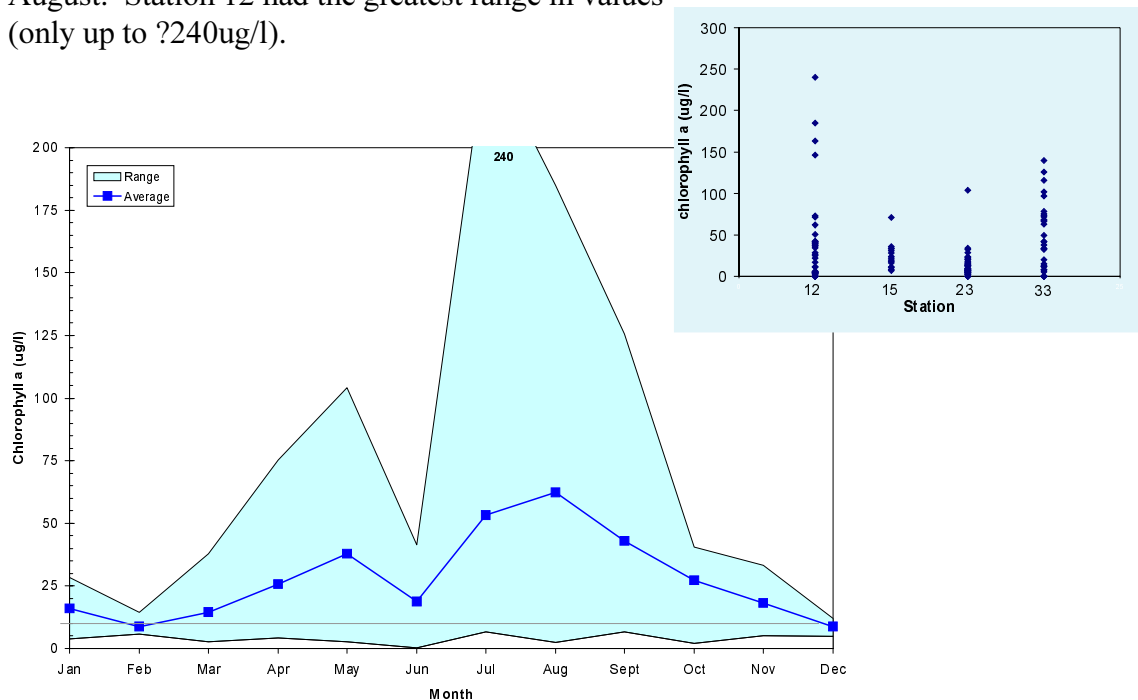


Figure XX: Monthly mean chlorophyll *a* concentrations in Assawoman Bay compared to range for 1997 - 1999. Insert graph shows chlorophyll *a* range by station.

Redfield Ratio (DIN:DIP)

Although the data is limited, redfield ratios show that Sinepuxent Bay may be nitrogen limited (e.g. phosphorus enriched at the molar level).

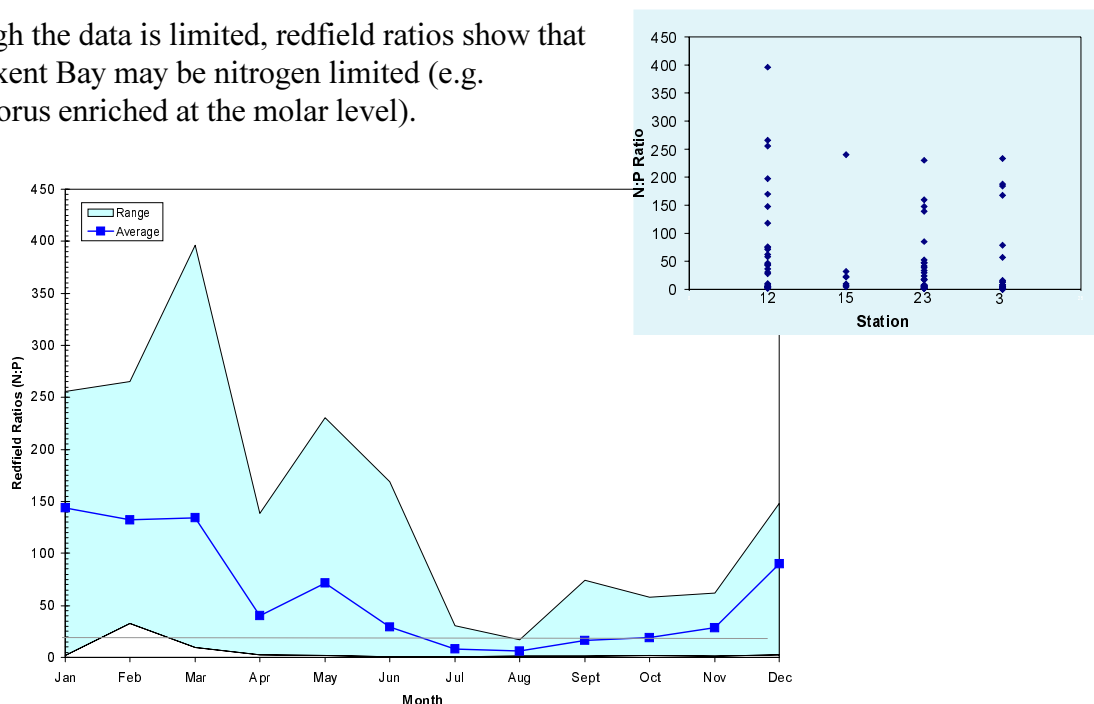


Figure XX: Monthly mean Redfield Ratios in Assawoman Bay compared to range for 1997 - 1999. Insert graph shows DIN:DIP range by station.

Seagrass Habitat Conditions

In 1998 66.7% of the SAV habitat requirements were met in Newport Bay while 84.6% were met in 1999. CHLA and KD requirements were not met 16.7% of the time in 1998. DIN requirements were generally met at all stations in both years except station 23, Trappe Creek. DIP requirements failed at Mason Landing and Trappe Creel in both years....

Site #	Location	1998	1999	TOTALS
12	Mason Landing	2/4 (CHLA, KD)	0/3 (CHLA, DIP, DIN)	2/7
15	O.C. Golf Course	NSD	0/1 (CHLA)	0/1
23	Trappe Creek	1/4 (KD, DIP, DIN)	1/3 (DIP, DIN)	2/7
33	Ayres Creek	2/4 (KD, CHLA)	0/4 (CHLA, KD, DIP, DIN)	2/8
TOTALS		5/12	1/11	6/23

Station 12 Mason Landing

This station is in the Newport Bay watershed. No other data has been collected from this area so this data provides a very good record. There is no documented seagrasses nearby. This station was monitored by Janet and David Foley between August 1997 and March 1999.

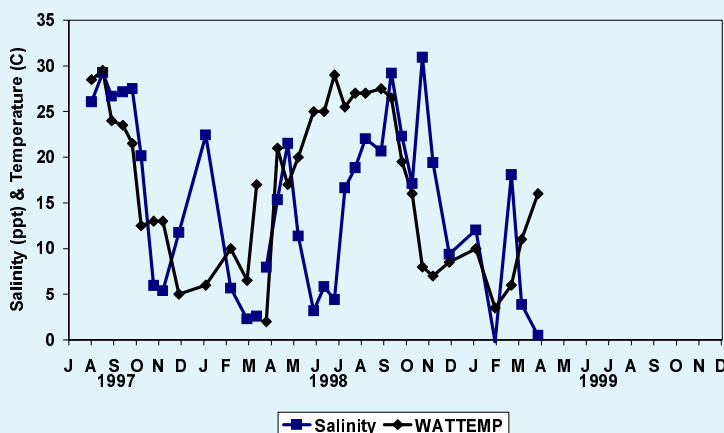


Parameter	Mean	Minimum	Maximum
Depth (m)	1.1	.8	1.5
Secchi (m)	.5	.3	.95
Temperature (°C)	17.1	2	29.5
Salinity (ppt)	15.3	.2	30.9
pH	7.6	6	8.5
chlorophyll a (ug/l)	44.95	2.64	240
Nitrate/Nitrite (uM)	29.57	0	188.5
Ammonia (uM)	9.8	.85	40.7
DIN (uM)	38	.9	188.5
PO ₄ (uM)	1.24	.1	13.24

Station Characterization

The average depth of this station was 1.1 meters with a 0.7 meter observed water level range. This station exhibited a wide range of salinity levels from 0.2 up to 31 ppt. The water temperature pattern is best described as a sinusoidal pattern of fluctuation throughout the year. The low records for the year are in December through March and the peak in monthly mean temperature is July and August. The pH levels are generally in range for marine life.

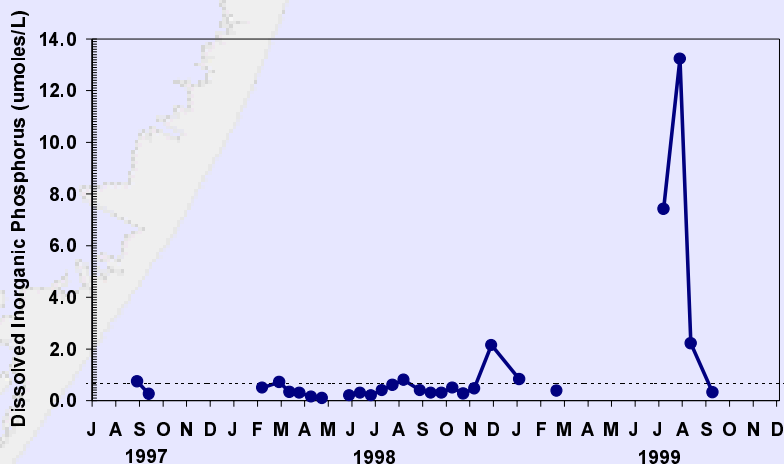
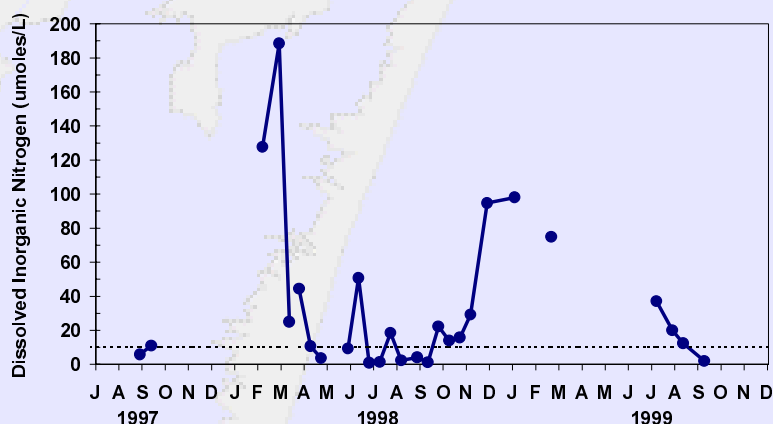
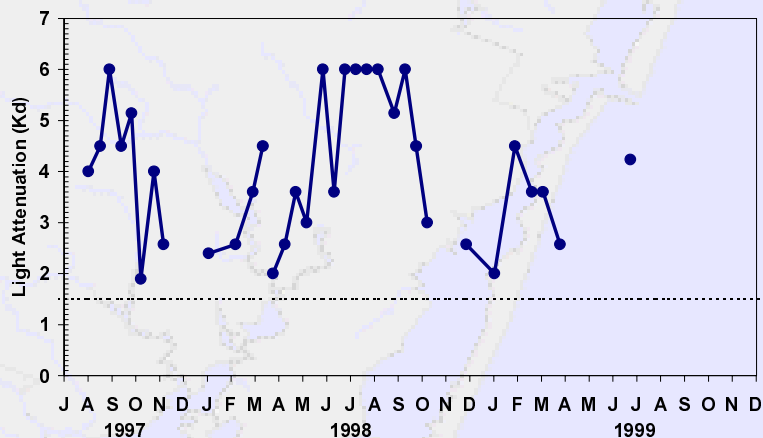
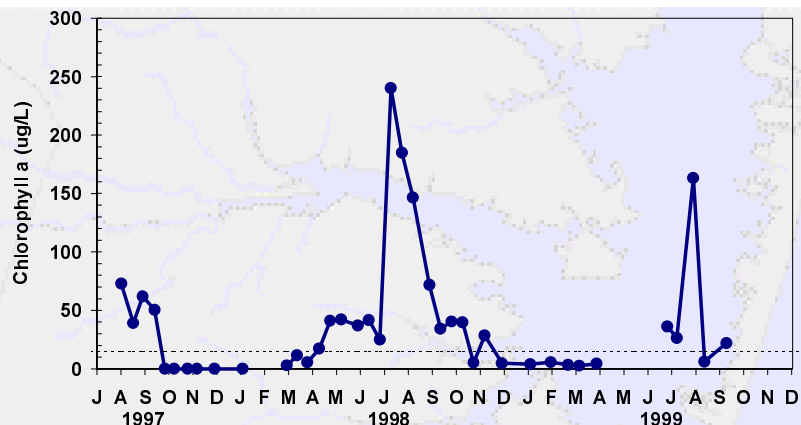
Station 12: Mason Landing



Seagrass Criteria

In 1998, DIP was met (median = 0.3). CHLA and KD did not meet SAV habitat requirements (medians = 40.4 and 4.34 respectively). DIN was borderline (median = 9.98) with 7 out of 14 samples exceeding criteria.

In 1999, all parameters were borderline however all medians failed SAV habitat requirements. CHLA and DIN were close to criteria with mean values of 16 and 24 respectively. DIP was especially high with a mean value of 4.8 and KD had limited data. The lack of data was due to the secchi remaining visible on the bay bottom; hence, there was sufficient light at that station for seagrass growth and it can be estimated that the area met the SAV requirement due to the mean depth of the station being greater than 1 meter (the goal of the habitat requirement).



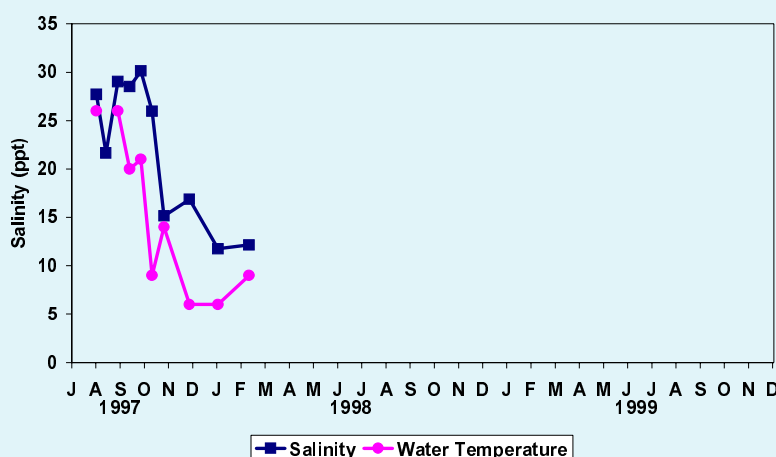
Station 15 Newport Golf Course

This station is located in the Newport Bay watershed within Gibbs Pond. There are no documented seagrass beds or other data collected nearby. This station was monitored by Chris Wade and Hollis Martin between August 1997 and August 1998.



Parameter	Mean	Minimum	Maximum
Depth (m)	.59	.4	.7
Secchi (m)	.46	.3	.6
Temperature (°C)	16.3	6	26.0
Salinity (ppt)	22.7	11.8	30.5
pH	8	7.7	8.5
chlorophyll a (ug/l)	24.56	6.8	70.8
Nitrate/Nitrite (uM)	8.4	1.77	33.6
Ammonia (uM)	5.63	2.93	8.63
DIN (uM)	10.79	1.77	33.62
PO ₄ (uM)	.64	.08	2.13

Station 15: Newport Golf Course



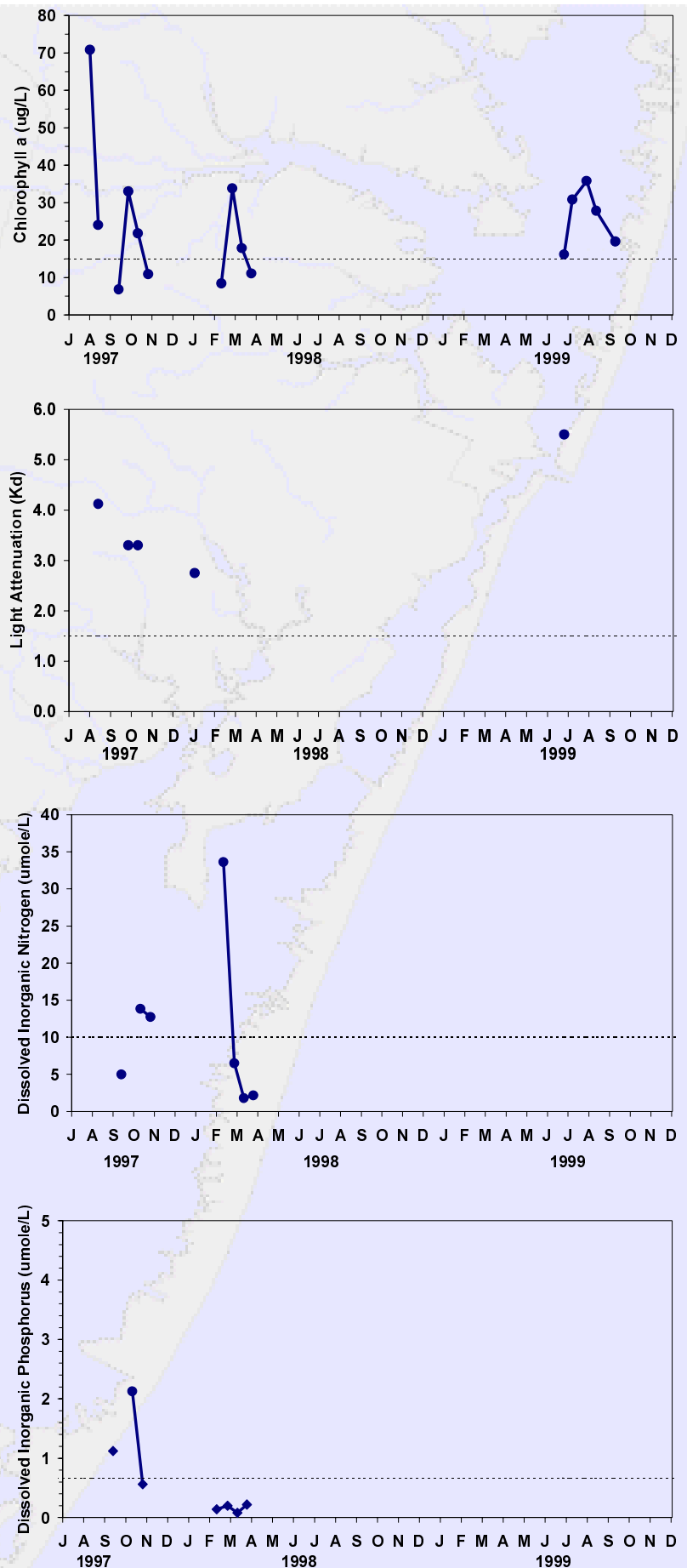
Station Characterization

The average depth of this station was 0.6 meters with a 0.3 meter observed water level range. This station exhibited variable salinity levels between 11.8 and 30 ppt. The low records for the year were in December and January and the peak in monthly mean temperature was in July and August. The pH levels are generally in range for marine life.

Seagrass Criteria

Not sufficient data to do analysis for 1998 (need a minimum of three sample dates spread out within SAV growing season).

In 1999, DIN and DIP was not measured. CHLA was borderline at the 0.05 level of significance; however, the median exceeded SAV habitat requirements 5 out of 5 samples (median = 27.8, $p = 0.06$). KD was borderline due to small sample size. The lack of data was due to the secchi remaining visible on the bay bottom; hence, there was sufficient light at that station for seagrass growth. It can not be estimated if the area met the SAV requirement due to the mean station



Station 23 Trappe Creek

This station is in the Newport Bay watershed. It is a very important station for loading and has been sampled since August 1997 providing a very good record. There are no documented seagrass beds nearby. Joan Hersey and Tess Foster have monitored this station.

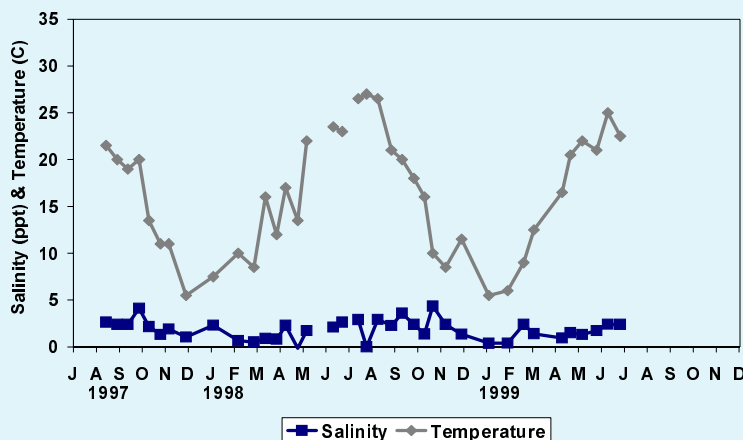


Parameter	Mean	Minimum	Maximum
Depth (m)	.7	.5	1.1
Secchi (m)	.52	.4	.7
Temperature (°C)	16.32	5.5	27
Salinity (ppt)	1.9	0	4.3
pH	6.9	5.3	7.5
chlorophyll a (ug/l)	13.1	0	104
Nitrate/Nitrite (uM)	149.4	35.1	503.9
Ammonia (uM)	28.4	1.4	110.8
DIN (uM)	171.8	47.8	503.9
PO ₄ (uM)	24.7	1.3	120.7

Station Characterization

The average depth of this station was 0.7 meters with a 0.6 meter observed water level range. This station exhibited freshwater salinity levels between 0 and 4 ppt. The water temperature pattern is best described as a sinusoidal pattern of fluctuation throughout the year. The low records for the year are in December and January with peak monthly mean temperatures in July and August. The pH levels are in range for marine life.

Station 23: Trappe Creek

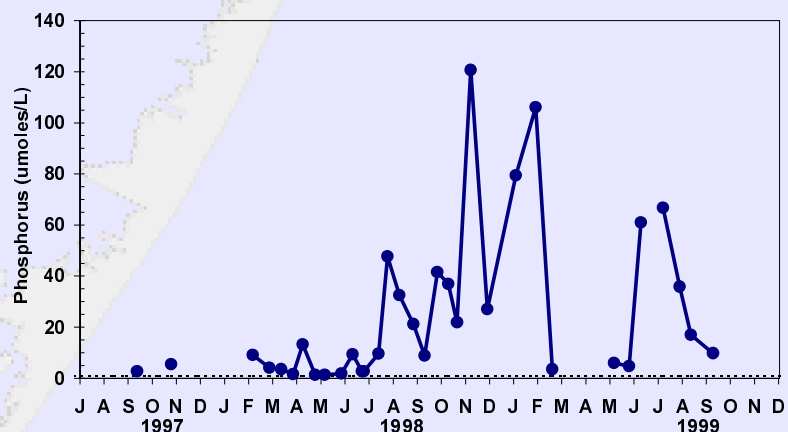
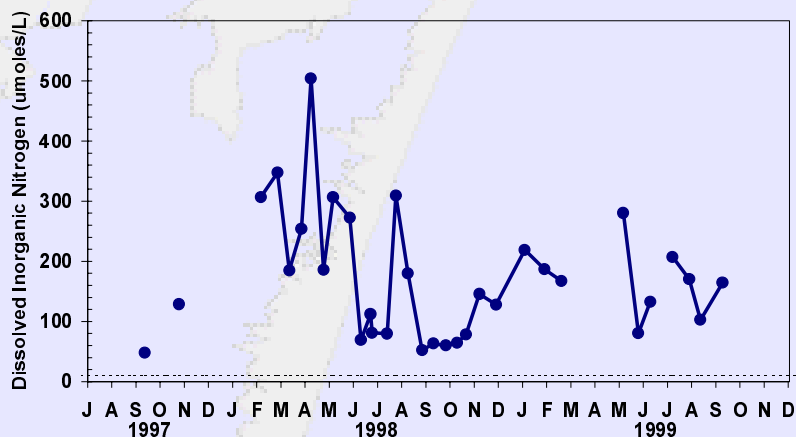
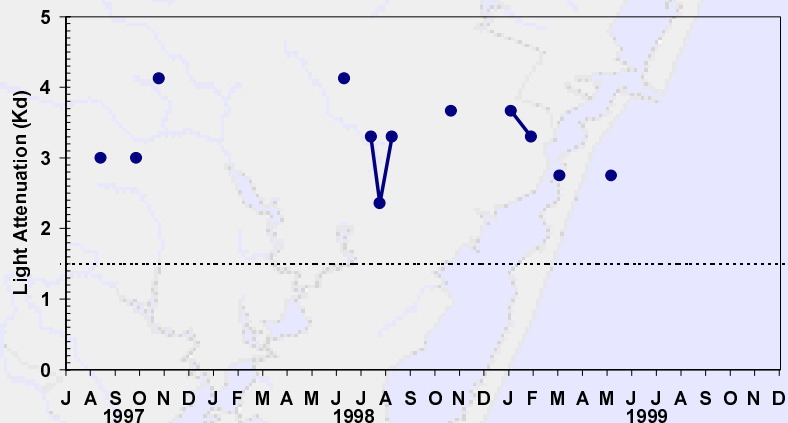
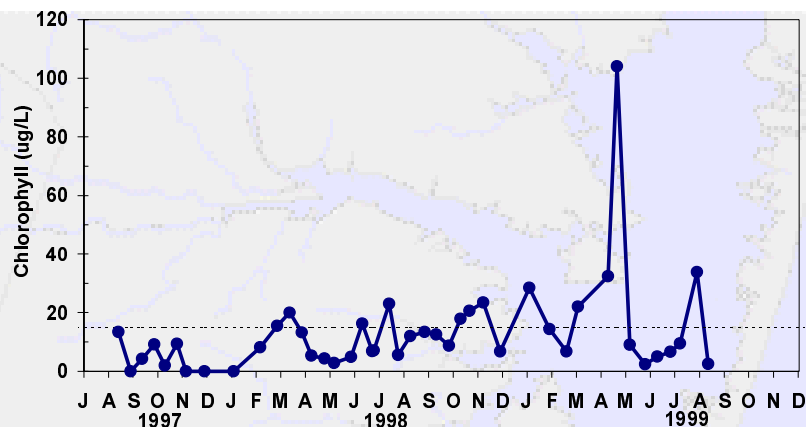


Seagrass Criteria

DIN and DIP did not meet SAV habitat requirements in 1998 or 1999. Medians were extremely high both years (145.83 and 9.1 in 1998, and 164.22 and 16.99 in 1999 respectfully). CHLA was borderline in both years with medians below habitat criteria (10.3 in 1998 and 9.02 in 1999). KD was borderline in 1998 with a median (6.6) way above SAV requirements. KD was not included in the analysis in 1999 because of lack of data. The lack of data was due to the secchi remaining visible on the bay bottom; hence, there was sufficient light at that station for seagrass growth. However, it can not be estimated if the area met the SAV requirement due to the mean station depth being less than 1 meter (the goal of the habitat requirement).

Relationship to Other Data:

Relationship to Pfiesteria site# TRC0059.



Station 33 Ayres Creek

This station is located in the Newport Bay watershed. There are no documented seagrass beds in the area. Phyllis Koenings has monitored this station since August 1997.



Parameter	Mean	Minimum	Maximum
Depth (m)	0.7	0.3	1.0
Secchi (m)	0.5	0.3	0.9
Temperature (°C)	18.45	6.0	37.0
Salinity (ppt)	13.29	.71	31.95
pH	7.7	6.7	8.9
chlorophyll a (ug/l)	67.65	.45	522.67
Nitrate/Nitrite (uM)	15.92	0	105.55
Ammonia (uM)	6.87	.35	37.84
DIN (uM)	21.46	.41	105.55
PO ₄ (uM)	1.04	.17	4.15

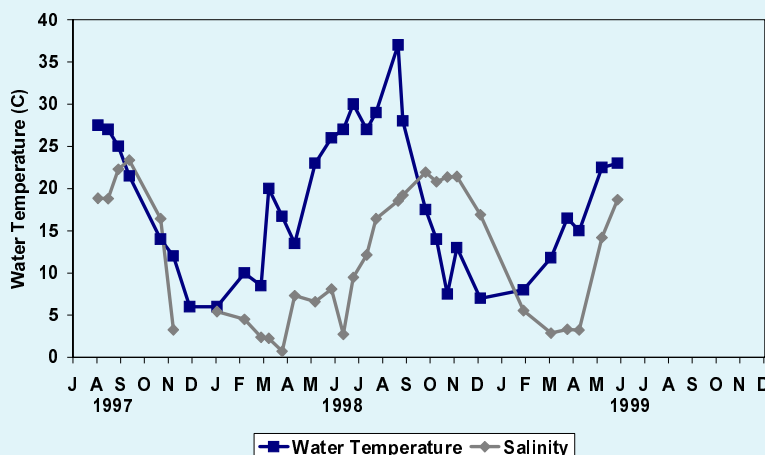
Station Characterization

The average depth of this station was 0.7 meters with a approximate 0.7 meter observed water level range. This station exhibited a large range in salinity levels between 0 and 32 ppt. The water temperature pattern is best described as a sinusoidal pattern of fluctuation throughout the year. The low records for the year are in December through March and the peak in monthly mean temperature is July and August. The pH levels are in range for marine life.

Seagrass Criteria

In 1998, DIN met habitat requirements while DIP was borderline with a median below habitat criteria (median = 0.6). CHLA and KD did not met habitat requirements. CHLA failed 11 out of 12 samples

Station 33: Ayres Creek



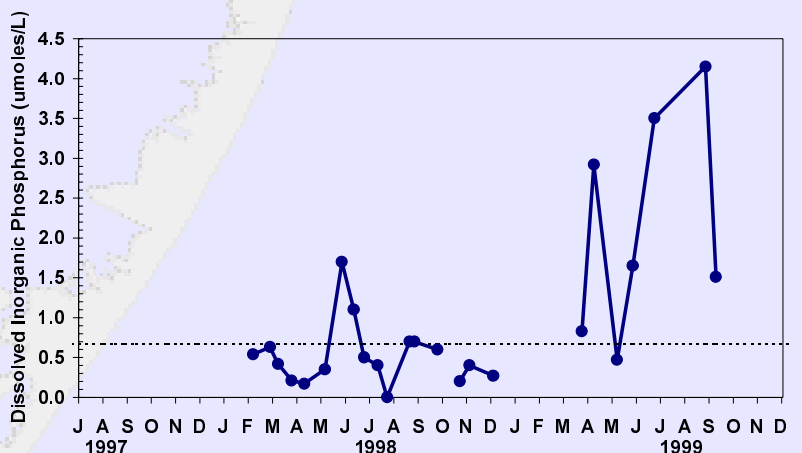
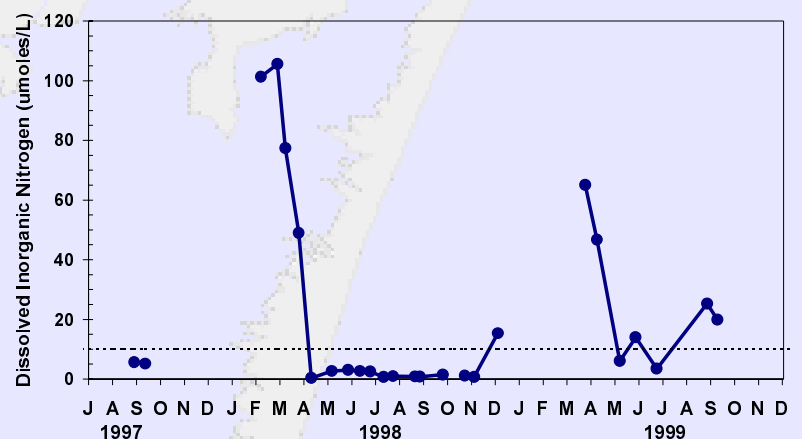
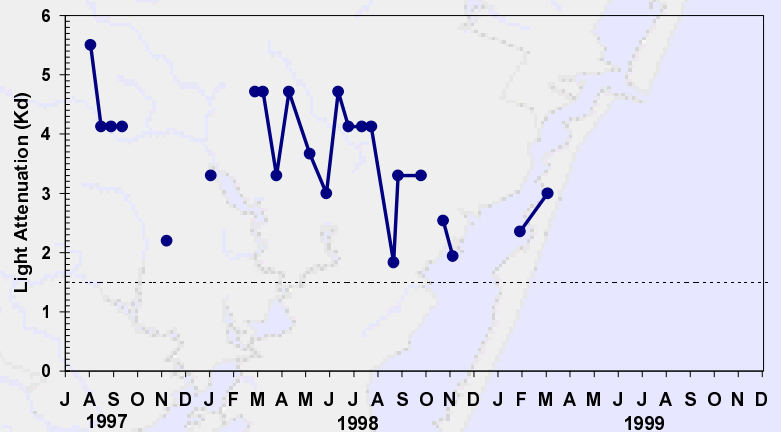
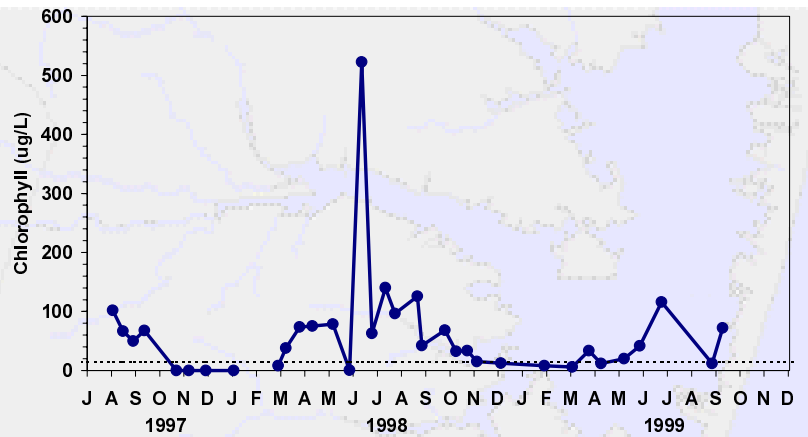


with a median (74.4) well above the SAV criteria. KD failed all 11 samples and had a median of 0.45.

In 1999 all four parameters were borderline with medians that did not meet habitat requirements. DIN failed 5 out of 7 samples with a median of 19.94. DIP failed 6 out of 7 samples with a median of 1.65. CHLA failed 5 out of 7 samples with a median of 33.6. KD failed 4 out of 4 with a median of 3.44.

Relationship to Other Data:

Relationship to Pfiesteria site# AYR0017.



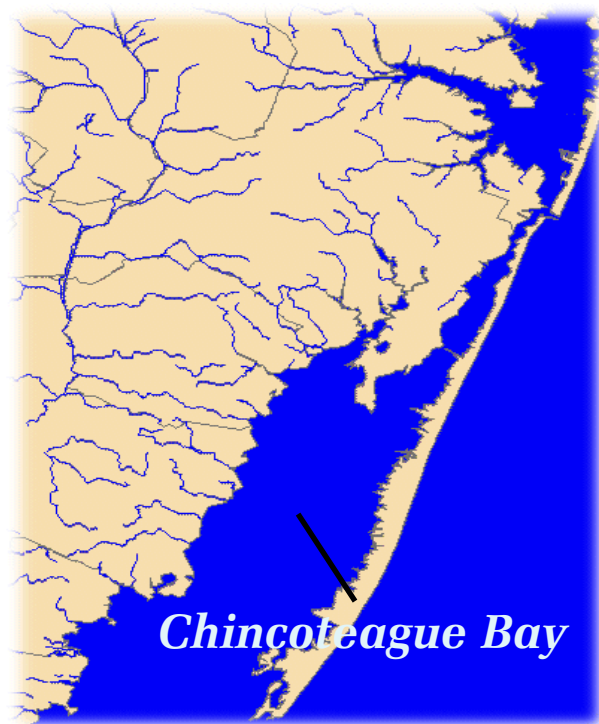


Chincoteague Bay had three stations.

Site 18 Figgs Landing

Site 20 Public Landing

Site 24 Kelly Point



Water Quality Status

Chlorophyll *a*

The annual mean chlorophyll value was 10.1 in 1997, 17.9 for 1998 and 7.4 for 1999.

The collection goal was met - 87.4% of chlorophyll samples were taken.

Chlorophyll *a* concentrations in Chincoteague Bay were above the SAV habitat value of 15 ug/l in June, July and August. Peak chlorophyll concentrations were in August.

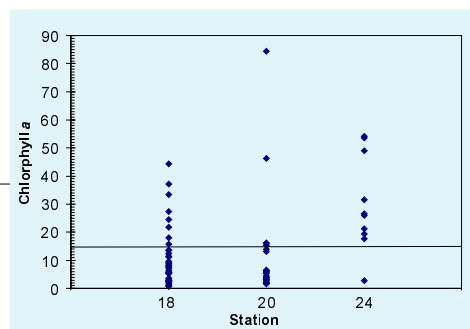
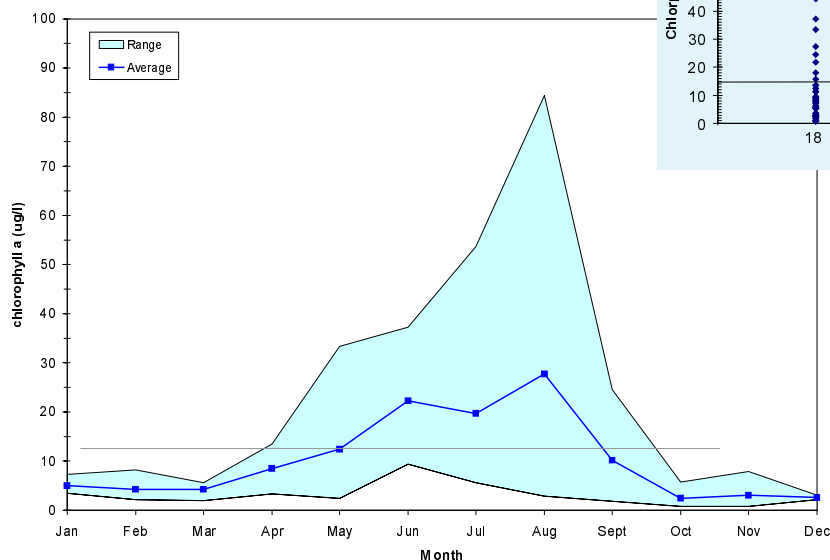


Figure XX: Monthly mean chlorophyll *a* concentrations in Assawoman Bay compared to range for 1997 - 1999. Insert graph shows chlorophyll *a* range by station.

Redfield Ratio (DIN:DIP)

Although the data is limited, redfield ratios show that Sinepuxent Bay may be nitrogen limited (e.g. phosphorus enriched at the molar level).

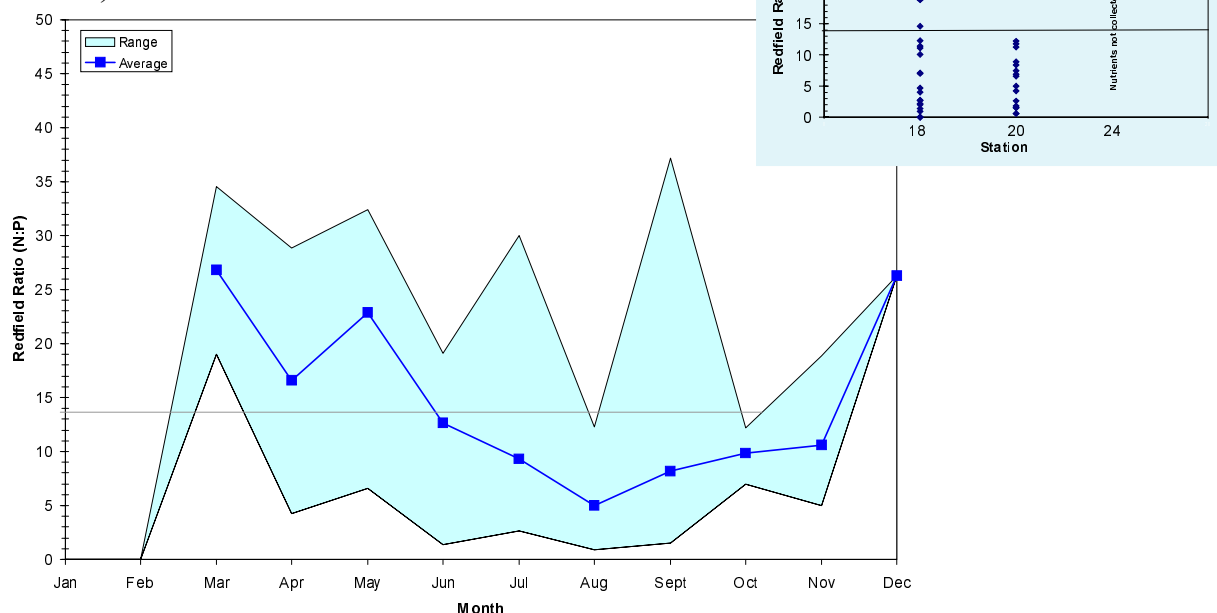


Figure XX: Monthly mean Redfield Ratios in Assawoman Bay compared to range for 1997 - 1999. Insert graph shows DIN:DIP range by station.

Seagrass Habitat Conditions

In 1998 44.4% of the SAV habitat requirements were met in Chincoteague Bay while 75% were met in 1999. KD requirements were not met 22% of the time in 1998. CHLA criteria was met at all stations except Kelly Point in 1998. DIN and DIP requirements were met at Figgs Landing and Public Landing (the only stations that measure nutrients in Chincoteague Bay) in both years.

Site #	Location	1998	1999	TOTALS
14	Hog Landing	ND	ND	0
18	Figgs Landing	2/4 (KD, DIP)	3/4 (KD)	5/8
20	Public Landing	2/3 (DIP)	3/4 (KD)	5/7
24	Kelly Point	0/2 (KD, CHLA)	ND	0/2
TOTALS		4/9	6/8	10/17

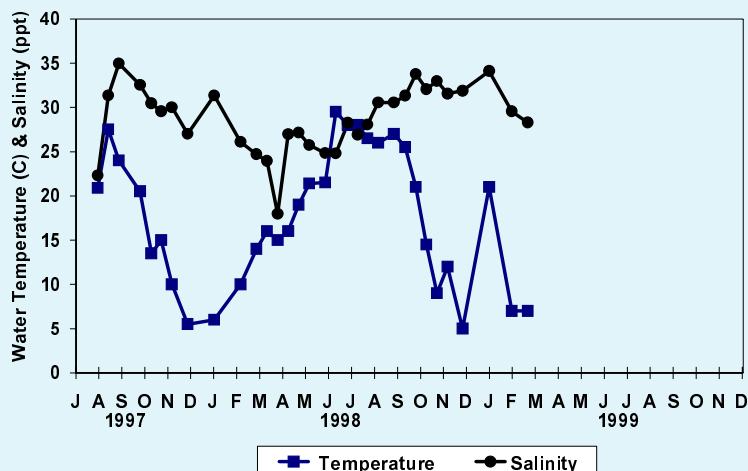
Station 18 Figgs Landing

This station is located in the Chincoteague Bay watershed. It has been collecting data since August 1997 and provides a thorough water quality record. This station is not nearby any documented seagrass beds and there is no similar data collected nearby. This station was monitored by Alice Tweedy from August 1997 through August 1999 and is not monitored by Jeff Figgs.



Parameter	Mean	Minimum	Maximum
Depth (m)	.85	.6	1.2
Secchi (m)	.5	.2	.8
Temperature (°C)	17.37	4.5	29.5
Salinity (ppt)	28.7	17.96	34.96
pH	8.1	8	9
chlorophyll a (ug/l)	10.05	.74	44.4
Nitrate/Nitrite (uM)	2.7	.07	15.3
Ammonia (uM)	4.73	.18	24.2
DIN (uM)	8.46	1.1	27.53
PO ₄ (uM)	.74	.06	2.4

Station 18: Figgs Landing



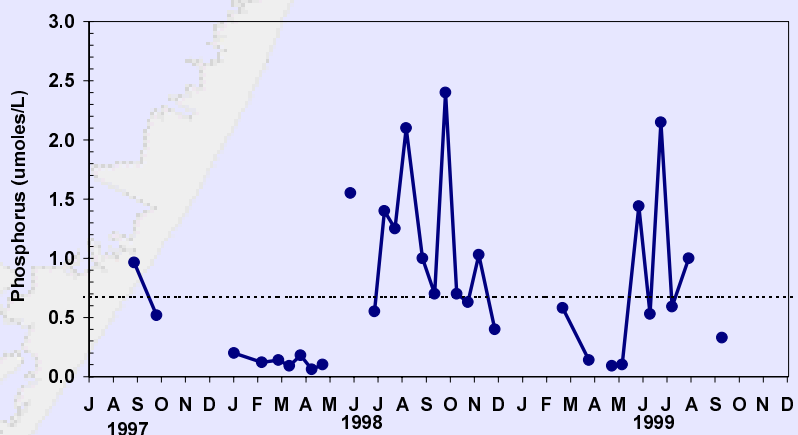
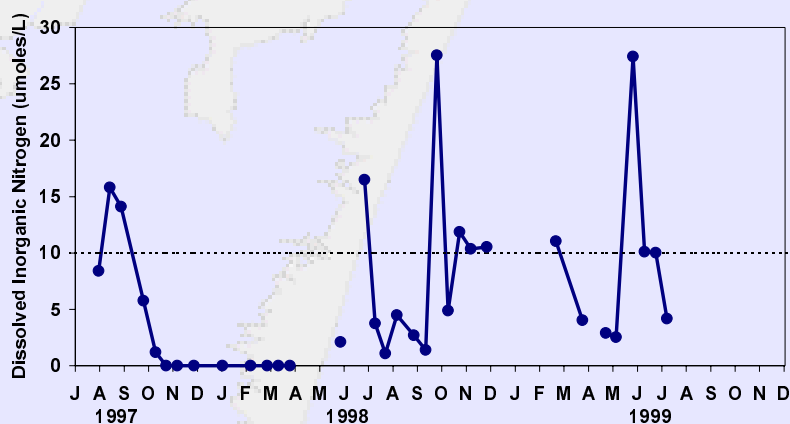
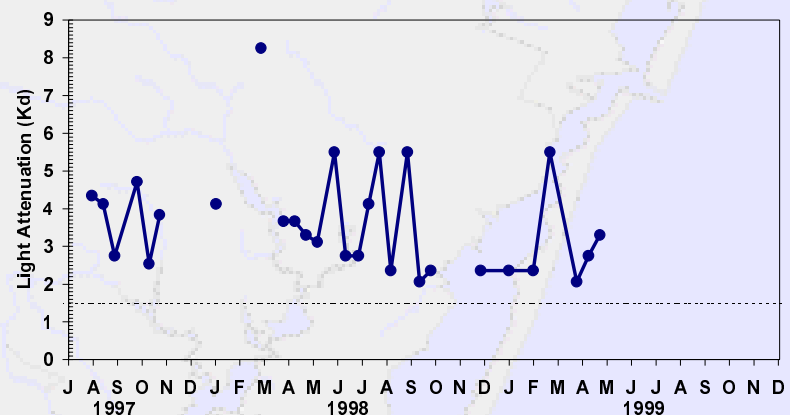
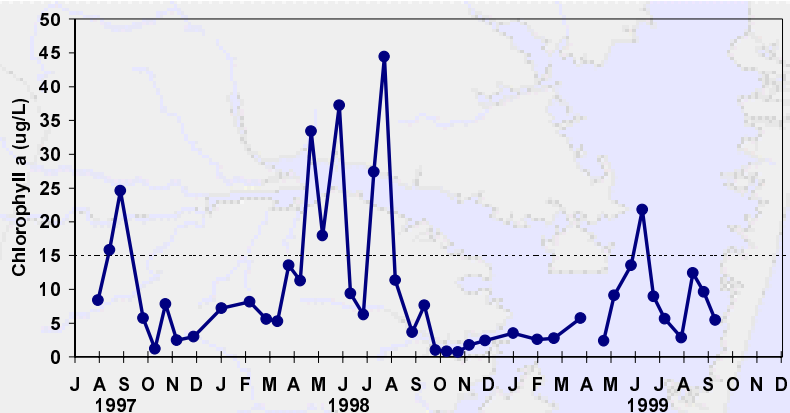
Station Characterization

The average depth of this station was 0.9 meters with a 0.6 meter observed water level range. This station exhibited polyhaline salinity levels between 18 and 35 ppt with the lowest salinities in the early spring. The water temperature pattern is best described as a sinusoidal pattern of fluctuation throughout the year. The low records for the year are in Decem-

ber through March and the peak in monthly mean temperature is June and July. The pH levels are generally in range for marine life.

Seagrass Criteria

In 1998 and 1999, DIP was borderline with median value approximately equal to the habitat requirements in 1998 (0.7). DIN was also borderline in both years with medians well below habitat requirements. CHLA was borderline in 1998 with a median below criteria (median = 11.3) and met criteria in 1999. KD did not meet SAV habitat requirements in 1998 (median = 3.3) and was borderline in 1999 but the median value did not meet habitat criteria (median value of 2.75)



Station 20 Public Landing

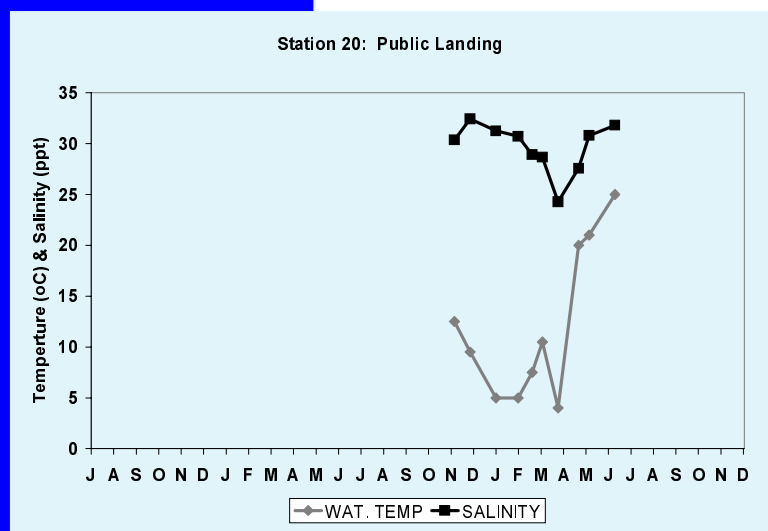
This station is located in the Chincoteague Bay watershed. This station is not located near any documented seagrass beds. This station has been monitored by Alice Tweedy since August 1998.

Parameter	Mean	Minimum	Maximum
Depth (m)	.86	.6	1.0
Secchi (m)	.36	.15	.65
Temperature (°C)	12	4	25
Salinity (ppt)	29.7	24.3	32.4
pH	8.2	8	9.5
chlorophyll a (ug/l)	11.24	1.65	84.4
Nitrate/Nitrite (uM)	1.26	0	6.32
Ammonia (uM)	5.39	.75	36.47
DIN (uM)	6.64	1.05	42.79
PO ₄ (uM)	.81	.09	1.9



Station Characterization

The average depth of this station was 0.9 meters with a 0.4 meter observed water level range. This station exhibited fairly stable, polyhaline salinity levels between 24 and 32 ppt. The low water temperature records for the year are in December through March and the peak in monthly mean temperature is July and August. The pH levels are in range for marine life.





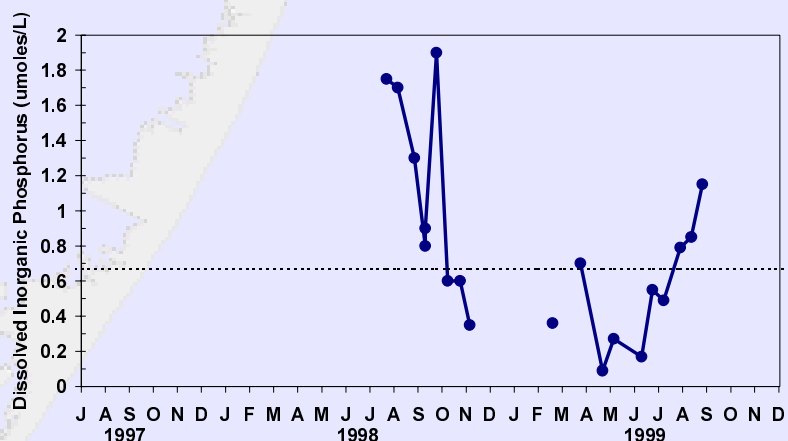
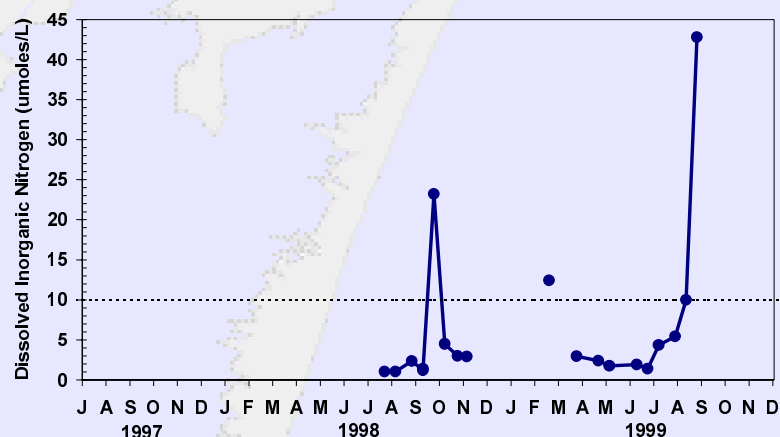
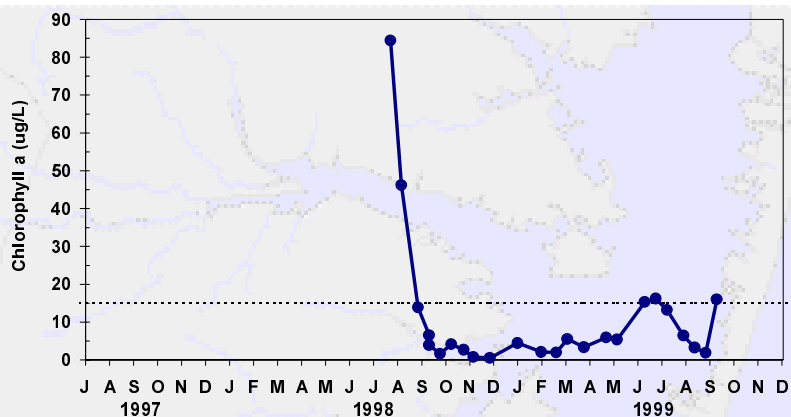
Seagrass Criteria

SAV habitat requirements were borderline for DIP, DIN and CHLA in 1998. Median values were below SAV habitat criteria for DIN and CHLA (medians = 1.3 and 5.35 respectfully) but exceeded criteria for DIP (median = 1.1). KD was not included in the analysis because of lack of data. The lack of data was due to the secchi remaining visible on the bay bottom; hence, there was sufficient light at that station for seagrass growth. However, it can not be estimated if the area met the SAV requirement due to the mean station depth less than 1 meter (the goal of the habitat requirement).

In 1999, DIN met SAV requirements (median = 2.98) while DIP, CHLA and KD were borderline. Growing season medians were within requirements for DIP and CHLA (0.55 and 6.22 respectfully) but was exceeded for KD (3.3).

Relationship to Other Data:

Relationship to National Park Service data for station 5.



Station 24 Kelly Point

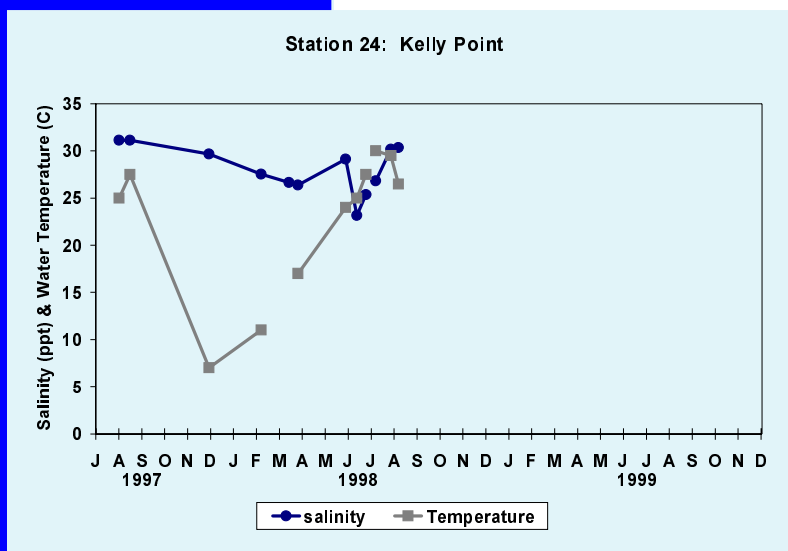
This station is located in the Chincoteague Bay watershed. There are no other water quality stations or documented seagrass beds nearby. This station has been monitored by Ray Jackson since August 1998.

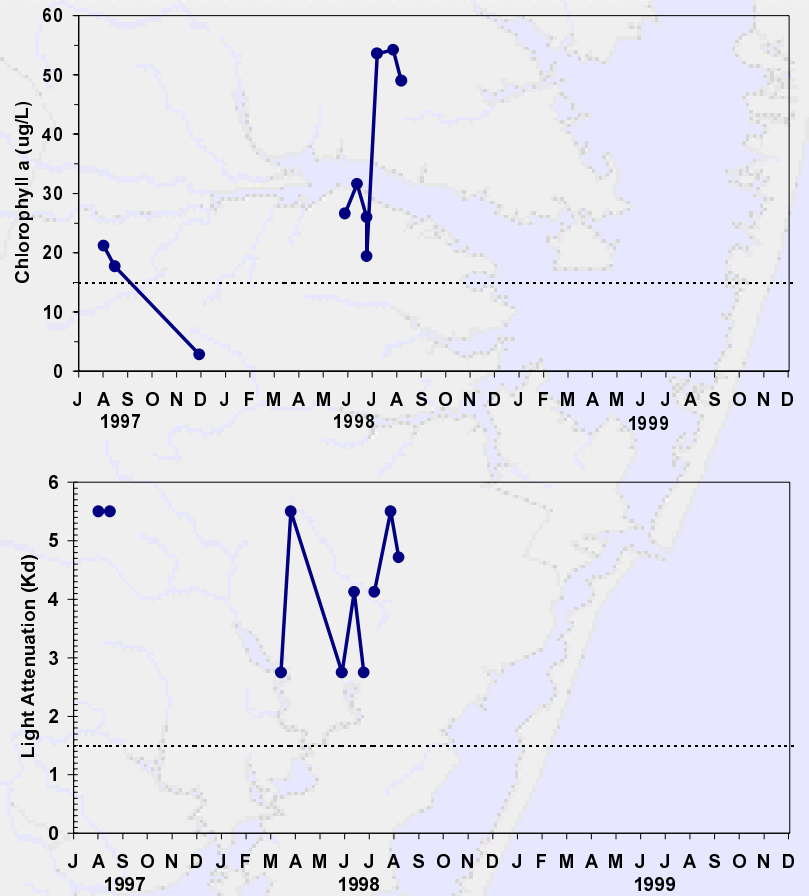


Parameter	Mean	Minimum	Maximum
Depth (m)	.82	.6	1.3
Secchi (m)	.42	.3	.6
Temperature (°C)	22.7	7.0	30.0
Salinity (ppt)	28.1	23.2	31.1
pH	8.2	7.5	9
chlorophyll a (ug/l)	30.2	2.8	54.2

Station Characterization

The average depth of this station was 0.8 meters with a 0.3 meter observed water level range. This station exhibited polyhaline salinity levels between 23 and 31 ppt. The low water temperature records for the year are in December and the peak in monthly mean temperature is July. The pH levels are in range for marine life.





Seagrass Criteria

This station does not measure the DIN and DIP habitat requirements.

Chlorophyll a levels and KD did not meet SAV habitat requirements in 1998 (failed requirements for all samples with medians of 31.6 and 4.13 respectfully). No data for 1999.

Relationship to Other Data:

Relationship to Pfiesteria site# XCM1562.

Station 10 South Point Landing

Chincoteague

Station Characterization

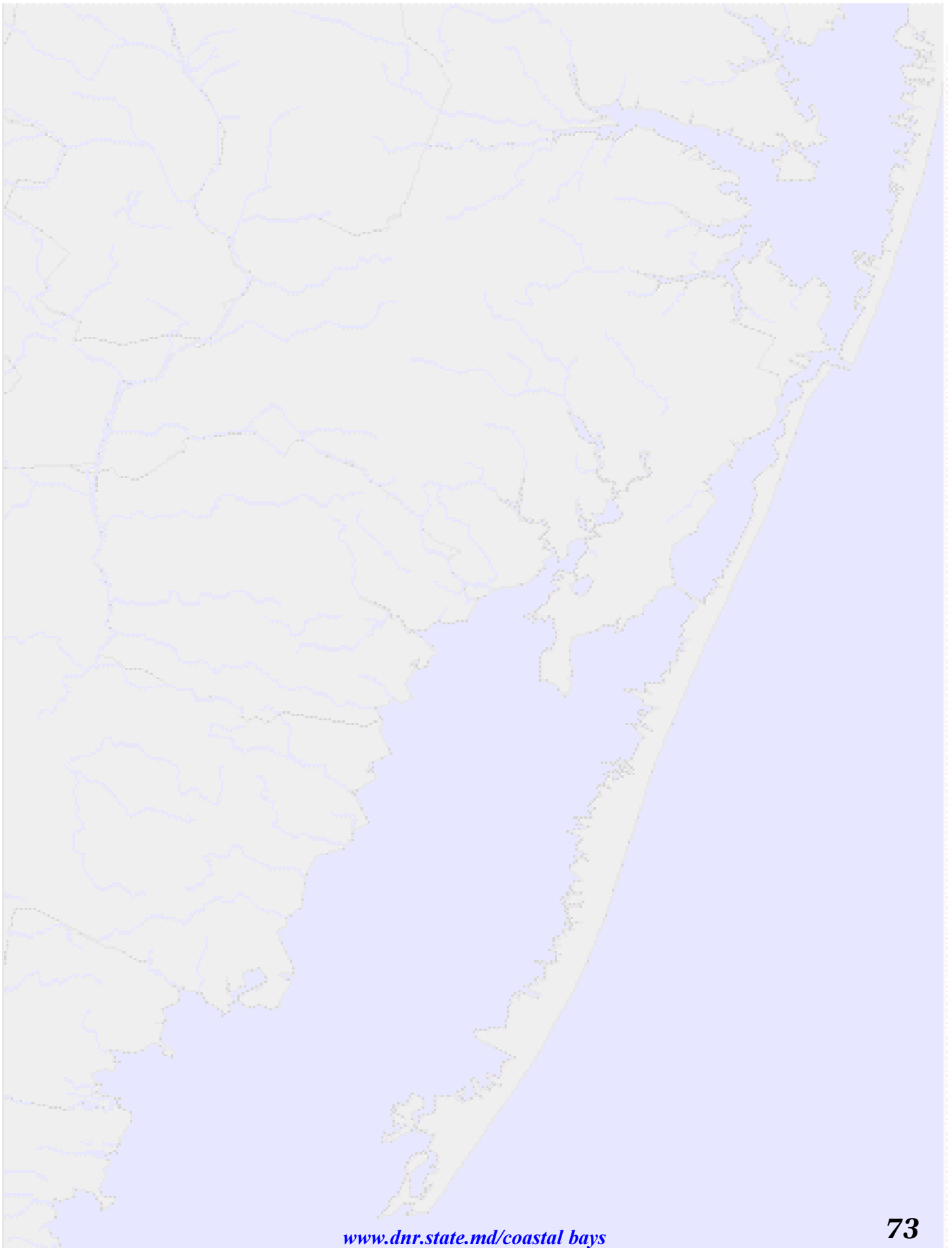
This station exhibited polyhaline salinity levels between 18 and 30 ppt with the lowest salinities in the early spring. The water temperature pattern is best described as a sinusoidal pattern of fluctuation throughout the year. The low records for the year are in December through March and the peak in monthly mean temperature is July and August.

Seagrass Criteria

Not sufficient data to do analysis (need a minimum of three sample dates spread out within SAV growing season).

Relationship to Other Data:

Relationship to Pfiesteria or National Park Service data???



Results/ Conclusions:

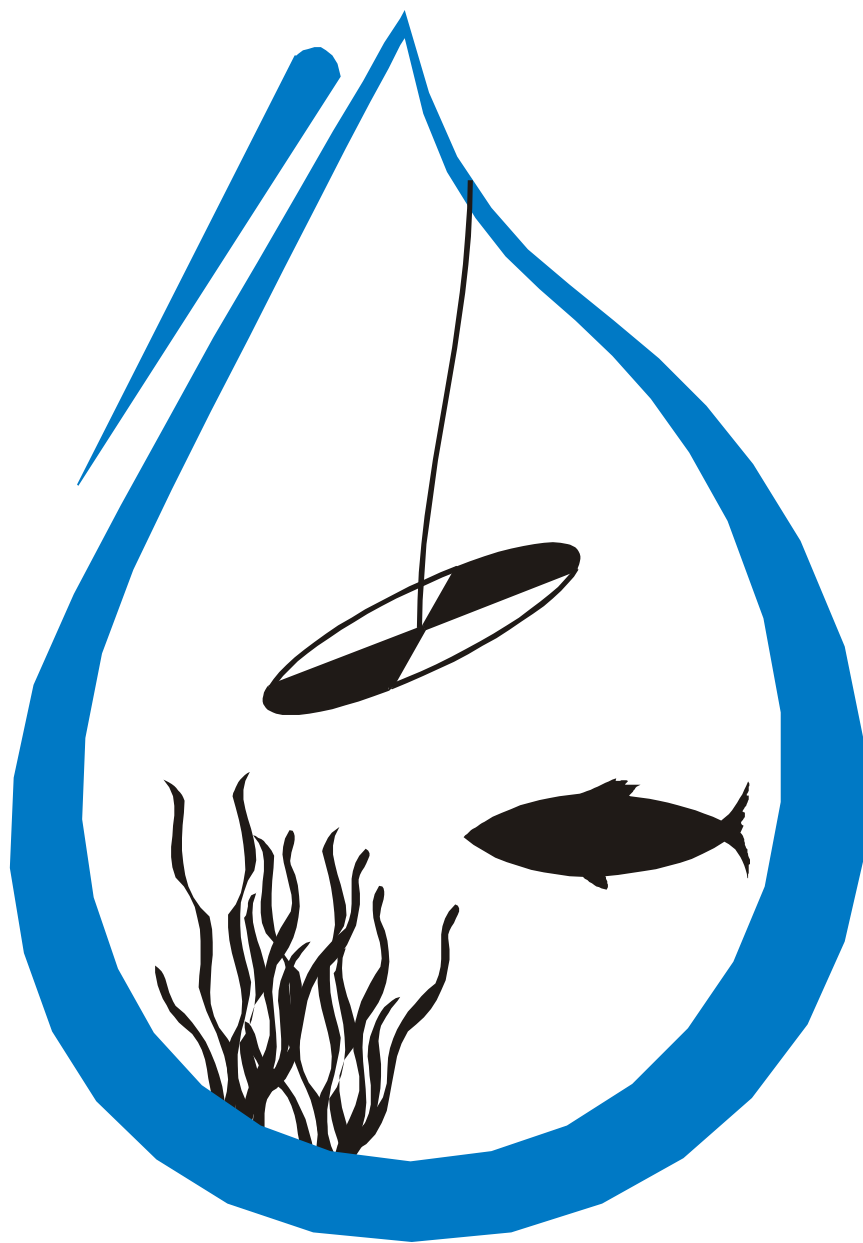
Appendix A: SAV habitat table.

Appendix B: Summary table of SAV habitat paramter results.

Appendix C: Comparison graphs with other State and Federal Data

Water Quality in the Coastal Bays

1997-1999



Based on Data collected by:

The Maryland Coastal Bays Volunteer Water Quality Monitoring Program

Water Quality in the Coastal Bays

1997-1999

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The Maryland Coastal Bays Volunteer Water Quality Monitoring Program

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Editors: Sherm Garrison, Dave Goshorn, David Blazer

Graphic Designer: Kathleen Freeman, MD DNR

Acknowledgments:

Over 60 people (see table 1) have volunteered their time over the past three years to collect water quality information and samples. Such a large scale effort would not be a... Special thanks to Ernie Edmond who transported samples to the lab in Delaware for analysis and to Walt Powers who helped obtain geographical reference information for each station. Lab analysis was performed by Ed Whereat and Joe Skudlark with the University of Delaware. The MCBP scientific and technical advisory committee helped design the monitoring program and the MCBP provided financial support for monitoring equipment, sample and data analysis.

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ADD LOGOS